C6985-7

OFFSHORE

1987 Edition

Offshore®

PennWell Books
PennWell Publishing Company
Tulsa, Oklahoma

Copyright © 1987 by
PennWell Publishing Company
1421 South Sheridan Road/P.O. Box 1260
Tulsa, Oklahoma 74101

Library of Congress cataloging in publication data

ISBN 0-87814-317-3
ISSN 0-891-9135

All rights reserved. No part of this book may be reproduced, stored in a retrieval system, or transcribed in any form or by any means, electronic or mechanical, including photocopying and recording, without the prior written permission of the publisher.

Printed in the United States of America

1 2 3 4 5 91 90 89 88 87

OFFSHORE YEARBOOK

1987 Edition

CONTENTS

SPECIAL FEATURES

Better Times for the Offshore Depend on Oil Prices 1
Robert G. Burke, Assoc. Publisher/Editor in Chief

Operators See More Data, Efficiency in Technology 5
Leonard A. LeBlanc, Engineering Editor

Business as Usual in Brazil; U.S., Canadian Offshore Depressed 9
Jim Redden, News Editor

Norway Takes the Lead as UK Falters in North Sea 13
Bart Milner, International Editor

ARTICLES

Subsea Production Technology: Past, Present and Future 19
Derrick Booth

Drugs Offshore: Companies Stepping Up Fight Against Hidden Adversary 27
Jim Redden, News Editor

War Zone Transit Hazard to Vessels 31
Leonard LeBlanc, Engineering Editor

Platform Removal Becomes International Issue 33
Jim Redden, News Editor

Marine Electronics 38
Leonard LeBlanc, Engineering Editor

Understanding New EPA Mud Rules 43
Maurice Jones

1987 Outlook 50
Warner Freire, Kenneth W. Waldorf, Svien Kjellesvik, Robert E. Howson, Magne Reed, Alan Jardine, John Huff and Pauli Jumppanen

SURVEYS

Boat Survey Indicates Changing Fleet 60
Deepwater Wells Survey 65
Worldwide Offshore Daily Average Oil Production 68
Producing Fields by Country 69
International Offshore Well Count 72
Offshore Gas Production 73
ROV Manufacturers and Contractors 74
Worldwide Survey of Offshore Production Systems 81
Offshore Rig Report (monthly) 86
The World Offshore (monthly) 98

MOBILE RIG STATISTICS

Mobile Rig Scrappings/Retirements 123
Mobile Rig Name Changes 123
Units Cold Stacked/Mothballed/For Sale 124
Mobile Rigs, Unit Types by Age 125
Worldwide Offshore Mobile Rigs 136

OFFSHORE ANNUAL INDEX 159

Better times for the offshore depend on oil prices

Robert G. Burke
Editor in Chief, *Offshore*

This offshore business has changed more in the last 18 months than in the previous 18 years. Not all these changes were for the best, either. Oil prices fell, the rig count went down, and equipment and supply firms suffered. So, having survived a lean and rugged 1986, the offshore industry goes into 1987 with plentiful trepidations.

But things aren't entirely bad. In the last few months, there's mounting evidence that change will take place, although that change could be slow in coming. For example, these are a few of the more promising trends:

Oil prices. This is always a leading indicator of what direction a drilling play will take. If prices go up, so does the drilling rate. The price of oil is now about $18 a barrel, up considerably from a year ago. Whether this price sticks or not is up in the air. There's even some evidence that drilling might start to go up, even if prices were to fall slightly from this figure. This price move is strongly encouraging and could prove the best news for the offshore industry this year.

Declining production, particularily in the United States. At first glance, this may not appear to be a good sign, but it really is. As production dwindles, operators sense a need to go out and drill for new supplies. This in turn leads to a pickup in all offshore activity. The decline in U.S. production is more severe than was expected, and this has already caused operators to reconsider drilling programs. The decline in 1986 was a stunning 800,000 b/d or about 10% of the current 8.3 million b/d, the lowest level of production for this country since 1970. A further decline of 300,000-500,000 b/d is anticipated for 1987. At some point, government planners and the oil companies themselves must recognize this fact and get back to drilling.

Natural gas. There are growing signs of a gas shortage coming. This has been predicted for years, but the signs show up more often now. Whether this happens in 1987 or 1988, the appearance of a gas shortage will kick off a new drilling boom with particular emphasis in the Gulf of Mexico.

Reduced costs. The cost of drilling an offshore well is down at least 50%, in part due to a surplus of drilling rigs. Cost for other services and supplies are down accordingly. This lower price allows companies to consider projects they might otherwise pass, or they may consider worthy projects at a lower price for oil. Either way, lower drilling costs should translate into more wells drilled at some time or another.

Streamlined companies. Over the past two years, oil companies examined operating costs and realigned the corporate structure. For some, this was extensive reworking. These actions resulted in substantial savings and leaner, more forceful corporate outlook. But now the work has been done. There's clear evidence the companies are getting in position to go after oil reserves again.

The price move

World oil prices have made a significant recovery, up to $18 a barrel from $7 last summer. Perhaps this isn't a miraculous recovery but at least it's a start. Most of this price gain comes from OPEC nations having come to a production agreement and stuck to that through the opening months of 1987.

As a result, world inventories of crude came down, falling at the rate of 2.5 million b/d in February, according to a study by George Gaspar, an analyst for Robert W. Baird & Co., Milwaukee. This rapid shrinking of the world's available oil stocks has led some economists to predict a substantial decline of 180 million bbl in the first quarter, a good portion of the 270 million surplus piled up in 1986.

If the OPEC nations stick to current production quotas of about 15.8 million b/d and world demand stays level or even increases somewhat, there is likely to be more reductions taken in the world's stockpile. And as the inventory goes down, the need to drill becomes more apparent to producers and operators. If the price of crude remains firm through the summer and fall of 1987, or if any decline is only slight, then the drilling industry can be expected to regain confidence and get back to drilling new wells, and that will be good news indeed for the offshore business.

OPEC actions

The step last fall by OPEC nations to slash 1.2 million b/d of production from member quotas could eventually be of more than temporary relief. By agreeing to set a price of $18 a barrel, they have effectively determined a floor price. Whether this sticks or not is uncertain. But in any event this action by OPEC may serve to lessen any drop in crude prices which does tend to fluctuate according to season.

Almost as significant is a decision by certain non-OPEC producers to join in these production cutbacks. Those accepting this new line are Egypt, Malaysia, Mexico, Norway and the Soviet

Union. If these countries stay in line and should the price level stay at around $18 or even just below that, many analysts predict an industry turnaround.

These recent happenings—a decline in oil stocks, higher prices, and agreement among major producers—might well fuel a series of drilling plays to occur in late 1987 and almost certainly by 1988. Drilling incentives might also spur this drive as an alarming drop in domestic production is registered in the United States.

Up until this year many economists figured a price of $20 to $22 a barrel was needed to spark more drilling. But a decline in drilling costs came about as the industry slumped, and these lower costs may alter the situation. Some now believe a price of $17-18 a barrel might do the same trick.

U.S. oil production

A key factor in any drilling resurgence is almost surely to be the production rate in the United States.

This becomes critical simply because of market size. Approximately a third, more or less, of world oil output is consumed in America. And while U.S. reliance on oil from the Persian Gulf is much less than it was 15 years ago, the amount imported from that region has climbed of late and Saudi Arabia has become a supplier of more importance. Anyway, the United States is obligated to share oil with members of the International Energy Agency, many in western Europe.

Crude oil production, without any doubt, is fast declining in the United States. In part, this is due to a deliberate move by OPEC last fall to drive out high-cost oil. Caught in this were thousands of stripper wells producing less than 10 b/d. As these wells came up for workover or maintenance, they were shut in, merely because the price of oil was too low to repay the cost of reworking.

After rising slightly for four years in response to higher prices, output plummeted by a stunning 833,000 b/d, or about 10%, between Febuary and December 1986, according to data released by the Energy Department. This decline, down to 8.35 million b/d, brought the nation's production rate down to the lowest levels since 1977 when import dependence reached its peak of 48%. Imports of crude oil and refined products currently account for about 38% of American consumption, up from 31% a year ago. At the time of the Arab embargo, the level was 33%.

Sometime during 1987, according to industry and government projections, production will fall an additional 300,000 to 500,000 bbl, or some 17% under the peak production of 9.6 million b/d reached in 1970.

The hope is that this decline could well trigger a series of events among oil operators and government planners. As their production dwindles, the operators must seek new reserves, even if oil is priced at $17 to $18. Government may enact incentives to encourage more drilling. Drilling costs are down 50% from four years ago, and this could easily be another incentive for drillers. All this could cause an initial recovery to take place beginning in mid-1987 and occuring through 1988.

World oil supply

The U.S. trade deficit is getting an enormous amount of attention today. Suddenly, the sheer volume of imported oil is being noticed. If oil stays at $18 this year, the bill for oil imported into the United States will go up at least $12 billion. The U.S. trade deficit was $170 billion last year, and oil at an average price of $14 a barrel accounted for 25% of that deficit.

By 1989, some believe OPEC will supply 20 million b/d or about 36% of the total world demand estimated at 56 million b/d. The sharp drop in non-OPEC exploration and production will cause even greater opportunities for OPEC in 1990–1995. To avoid a sharp decline in non-OPEC production, this market will count heavily on gains from Colombia and Brazil in South America, as well as Norway, Egypt and Italy. Other gains in South Yemen and offshore China will help.

The North Sea may not be of much help. Production there may already have peaked at 2.65 million b/d. According to informed sources, considerable new exploration is needed to avoid a drop of 250,000-500,000 b/d before 1990.

Offsetting this trend in the United Kingdom is a production gain by Norway in 1986 to 1,050,000 b/d, up from 850,000. But this is not enough to replenish the non-OPEC oil supplies on a world-wide basis, and more drilling is needed, notably in the offshore areas where much of the future reserves are likely to be discovered.

Surging demand

Among all of the world's nations, the United States uses more energy than anyone else. The U.S. has a per capita consumption which is more than two and a half times greater than Western Europe or Japan and a ratio of energy to gross national product at least two times larger.

Considering oil products only, the average American consumes 26 barrels of oil a year. Compare that to 13 barrels for the average Japanese and 11 barrels for an average European. At the same time, the American relies on imports for 35% of his oil consumption. Japan imports all of its oil, and Europe has to bring in more than 60%.

Only now have industry analysts and government planners come to an agreement that the United States is almost inevitably headed toward new oil shortages despite higher prices and a more stable market. After nearly a year of wild fluctuations in which the oil price was cut roughly in half, the OPEC countries now seem capable of maintaining a price of about $18 a barrel.

Unless more drilling is accomplished soon, these specialists believe that dependence on foreign oil in the United States could reach a dangerous 60% by 1995. This in turn implies renewed control of the oil market by the OPEC countries.

The latest and perhaps strongest warning came recently from Interior Secretary Donald P. Hodel, former Secretary of Energy. He predicts, "people

will be sitting in gas lines again any time within the next two to five years."

Drilling trends

By almost any count, drilling statistics are dismal.

The rig count for the United States tumbled to 663, the lowest figure since 1940 and down considerably from the peak of 4,530 active land rigs in December 1981. While these figures have improved somewhat in the early months of 1987, there's no question that a drilling slump continues to exist.

In the offshore, that downward trend is apparent. During 1986 the utilization rate for active offshore drilling rigs in the United States slumped to 25% before rebounding to 40% by yearend 1986. On a worldwide basis, the utilization rate fell to 55%.

Most analysts predict a stronger market for offshore rigs in the Gulf of Mexico, primarily due to a pickup in natural gas exploration, with a rig utilization rate there rising to 50-55%.

Among these forecasters, George Gaspar seems to be the most optimistic. "In 1987 we envision a stronger Gulf of Mexico market with a utilization rate rising as high as the 50-55% range, primarily due to an expected pickup in natural gas exploration and development activity."

He sees more indications for improvement in production and development work for the offshore. "We have tracked a considerable number of new production platforms that have been idle since being completed and are now coming on stream. We also forecast sharp production decline curves on existing fields that are now moving into third and fourth year production. This will encourage gas buyers to begin contracting soon for longer term supplies. Hence, the domestic offshore rig market outlook appears better to us than the international sector with the exception of Brazil where offshore activity continues to have an expansionary overtone. Non-North American drilling is likely to be down 5% on the year."

Gaspar predicts that drilling in the Gulf of Mexico will pick up soon. "Beginning in 1988, we envision a strong upsurge in domestic exploration activity (and possibly as early as the fall of 1987) extending throughout the balance of this decade into the early 1990s. These projections assume a stable or modestly expanding general economy. If the United States were to experience a recession in 1987, particularly if the downswing was severe, reduced petroleum demand could delay the uptick in exploration funding by a year or so."

In any event, he does not expect to see a return to the best year figures in 1981. "While we are not likely to see a return to 4,800 rigs operating in the United States, sharply reduced rig equipment costs, more efficient equipment utilization and the incentives of more favorable U.S. oil and gas pricing should lead to an exploration boom carrying into the early 1990s that may remind us of the 1979–1981 period."

Operators seek more data, efficiency in technology

Leonard A. LeBlanc
Engineering Editor, *Offshore*

A projected long-term restraint on oil and gas prices has forced offshore operators to revise technological development and research programs to fit the most immediate needs.

Selected exploration and production technologies which can make dramatic inroads on offshore costs are continuing full tilt, courtesy of major U.S. and European operators who see the huge benefits at stake. Several major trends are in motion:

Technology research funds are shifting from downstream to upstream: Upstream investments in improving exploration seismic and geological technologies pay off in reducing the ratio of dry holes, so operators are putting less money into downstream technologies.

Information/data technologies are getting maximum funding: In every facet of exploration and production, information handling through new technology presents the most apparent reduction in manpower and costs.

Equipment development will remain at a low for 2-3 more years: With very few wells to drill or produce, equipment development and deployment has become an unaffordable luxury.

More production functions are being moved subsea: Positioning and maintaining equipment in the environmentally-severe wave zone is expensive, hence operators are moving as much equipment to the seafloor as possible.

Operators are funding most technological development: After pumping up quality requirements through contract specifications, operators are making lowest bid the only criteria in awarding contracts. In a survival mode, contractors and service companies have no money to undertake product improvement.

Technology development in any facet of the petroleum industry moves on a roller coaster shaped curve, peaking at periods of maximum evolution, meaning that one product triggers follow-up development of several other dependent technologies, and falling during periods of faltering benefit.

The peak of the curve for equipment development generally ended around 1980, just before companies were forced to deal with maximum product prices and maximum utilization.

The demand for informational and data technologies surfaced just as hardware demand fell. Two reasons are apparent: (1) the data handling technologies were becoming widely available at modest prices, and (2) companies adept at securing data and deriving benefit from it were outproducing those less successful.

Equipment and structural technologies are lagging behind the informational and data changes in the industry, but the upturn for equipment development will return within a period of 2-3 years. By that time, it will become very apparent that the best data and finest software cannot drill or produce a well.

Emphasis upstream

In the current price climate, operators have three options for improving their reserve position for the long term: drill the best prospects, farm out whatever cannot be expensed, and buy the reserves by acquiring smaller companies. As long as it is as cheap or cheaper to buy up reserves, operators are expected to continue doing so. Buying up reserves through acquisition of other companies brings up the first priority in technology—accurate reservoir volume assessment.

While traditional methods of estimating reservoir volumes and areal displacement have changed little over the years, some new tools have been added. Vertical seismic profiling (VSP), a method of sending and receiving seismic signals from one borehole to another to define the area between, is improving reservoir assessment. When the number of wells aren't available to support VSP operations, then surface seismic is being rolled into the picture by interacting the data graphically to provide a 3-D picture of the reservoir.

But the technology changes don't end there. New equipment is able to determine permeability and porosity and other physical factors from smaller core samples. Faster computers armed with new and more powerful software are aiding reservoir engineers in estimating volumes. Because so many companies were seeking to buy smaller companies, independent reserve verification had to be sped up.

Look before drilling

Marine lease operators are concentrating their exploration funds on maximizing decision-making prior to drilling and preventing dry holes from being drilled in the first place. In spite of the budget squeeze, some operator cash and entreprenueurship are quietly showing in four major areas of drilling.

New sensors, tools, and computers enable operators to gather and organize all information from downhole and the drill floor.

Computer software is providing assistance in pre-drilling simulation of downhole conditions and organizing data to provide real-time solutions for drilling problems.

Downhole tools are providing more information to the surface and in controlling the course and action of the drill bit.

Modest improvements in drill floor equipment and devices started when crude-price conditions were better, are showing up on the drill floor.

Historically, improvements in drilling technology have come slowly. The reasons are two-fold: (1) contractors are hesitant to use new and improved technology, so who proves it up first. (2) During periods of great activity, contractors focus on getting equipment on line, but during poor times, none can afford the needed research and development.

This throws the responsibility for improvements on the operator's shoulders, who is not always organized to budget for the research, nor to provide the means to spin off the technology, once acquired. Shell, Exxon, Chevron, Mobil and Gulf have led the way in many past developments, but this infusion of technology began to slow by 1984.

Drillsite computerization and real-time monitoring and telemetry of real-time information remain one of the most dramatic changes on the rig floor. Three successive generations of drilling data acquisition systems have changed the way rig information is gathered and used.

Real-time monitoring of rig parameters allows drillers to use the information and calculation of variables to immediately respond to problems downhole or alter the course and motion of the drill bit as required by the drilling plan. As a result, drilling efficiency is up considerably from previous years. In addition, and problably more importantly, safety has been improved.

Expert systems, such as those developed by mud companies to deal with downhole problems, are providing better support for decision-making at the rig site.

One of the stumbling blocks to further computerization of rig functions and parameter measurement is the quality of sensor equipment. Data handling capabilities have now far exceeded the reliability of sensors.

Drilling measurement

Another area of maximum investment in technological improvement in the drilling sector is measurement while drilling (MWD) instrumentation and data handling.

MWD tools and sensors use microelectronics, which are subject to frequent failure in high temperature, pressure, and jarring conditions. The mean time between failures (MTBF) is notoriously short. For some MWD equipment, it rarely exceeds 100 hours. Developers are working to extend the MTBF for MWD equipment.

In addition to monitoring drillstring and bit dynamics (bit direction, bit inclination, gamma ray, pressure, temperature weight on bit, drillstring torque), one of the most recent additions to MWD capability is the monitoring of electromagnetic wave resistivity and neutron porosity.

MWD is vastly more important for offshore wells than for onshore because of the incidence of directional drilling.

Horizontal drilling

Most offshore development wells share a common characteristic. Virtually all are directionally drilled, meaning they are not drilled vertically. Development drilling is achieved by means of a central location offshore, either a fixed platform, a floating production system, or a template through which a mobile rig has undertaken the development drilling.

In attempting to reach the outermost limits of the reservoir from one seabed location, most of the development wells must, of necessity, be directional. Once a directional well reaches an inclination of 45°, wireline logging becomes difficult. Wireline tool weight is rarely sufficient to overcome the casing and well wall surface friction at high angles.

Directional wells only approach what a newly developed capability, horizontal drilling, is achieving. Horizontal drilling not only has the ability to reach the far edges of the reservoir, but also perforations at various points along the production tubing and casing will allow a greater production volume, providing the depth interval has been carefully calculated in advance.

Horizontal wells are kicked off at a much more acute angle from the vertical wellbore than directional drilling. The equipment is vastly different for the most part and drilling speeds are much slower in the horizontal direction.

In addition to drill floor and downhole technological changes, options for the choice and phasing of crude and gas development and production options are also underway.

Options for marginal fields

One of the most significant technologies enabling a wide choice of development and production systems offshore is the seafloor template. It can provide for a choice of conventional fixed, subsea, floating production, or drilling options.

Templates can interface with many types of subsea equipment and the latest developments have provided for diverless installation, hookup and maintenance in the deepest water considered for production.

Rather than taking on the full cost of a platform initially, the operator can phase in the investment by installing a template and pre-drilling production wells. Long-term testing of production wells drilled in this manner will provide much better information for operators in deciding on a permanent production system.

One of the keys to the use of diverless hookup and maintenance of templates and wells is the

remotely operated vehicle (ROV), equipped with a real-time television camera and hydraulic manipulator arms. While they have operated offshore now for over ten years, the ROV has only recently been provided with the tools to interface with template equipment and controls.

The lag on offshore production for many years was the ability to install and maintain a fixed platform. The industry is no longer constrained by this need.

Floating production systems now have the ability to moor in 3,000 ft of water, aided by newly developed lightweight anchor cables, with attached chains and buoys. Further research on Kevlar and other aramid fibers that are neutrally buoyant will also provide additional options in the future when production depths surpass 3,000 ft.

Platforms in the future?

One of the most exciting developments in offshore technology is multi-phase production and flow. The ability to produce any combination of oil, gas, water, and heavy compounds such as paraffin and pump it through long pipelines to shore or to a central production platform will mean tremendous savings in fixed and floating production systems.

Of necessity, three elements must be efficient and reliable before such production can even be considered:

(1) a high-pressure, long-life pump must be able to take production from the well and push it effectively to its final destination,

(2) a method of keeping the liquid-gas-solids production in solution and uniformly slugged or mixed to appropriate turbulence in route to its location for separation, and

(3) a method of keeping the production stream under relatively constant pressure and temperature through the pipeline to prevent solids built-up or overpressurization at some point in the line.

The appropriate pumps with subsea power cabling are now being developed in the UK to serve subsea production stations. Chemical treatment injection and insulated pipelines are now under study.

A seafloor production system for many types of locations can become a reality within ten years. This will allow offshore production systems to reach near parity with onshore production for the first time in 40 years.

Operators were drawn offshore because of the size and productivity of offshore reservoirs, not the challenge. Offshore operations have always been 3–4 times more expensive than onshore. When subsea production systems become common, this will no longer be the case. Field marginality will be near that of onshore reservoirs.

The last remaining obstacle to substantial reduction of offshore costs is the drilling of offshore wells. Other than the ability to operate in more severe weather, drilling cababilities have changed little.

It is not impossible to consider that engineers should be able to transfer some functions (mud handling and well control to begin with) to the seabed in the coming years while maintaining minimum exposure in the wave zone.

While these types of revolutionary changes are difficult for many operators and contractors to consider at the present moment, seafloor production, diverless monitoring and maintenance, real-time monitoring of drilling functions from 3,000 miles away, and the computer-aided search for shallow stratigraphic reserves were all difficult to comprehend only 10-15 years ago.

Business as usual in Brazil; U.S., Canadian offshore depressed

Jim Redden
News Editor, *Offshore*

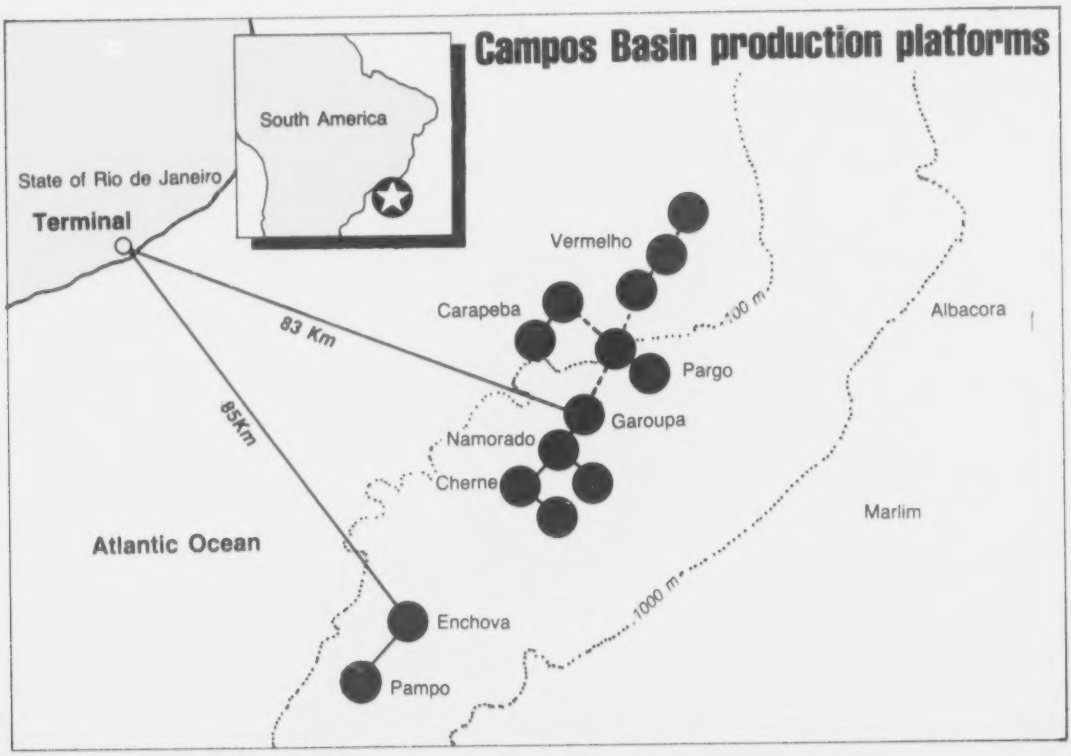
Any discussion of Western Hemisphere exploration and production activity must begin and end with Brazil, which has become one of the world's hottest offshore theaters.

While mobile drilling rigs earmarked for the Gulf of Mexico, California, Alaska and Canada sit on the unemployment line, Brazil is pushing ahead as though there is no depression in the petroleum industry. At the beginning of 1987, the utilization rate for rigs working Brazil's deepwater basins was an unheard of 100% with 51 units actively turning to the right.

For Brazil's state-owned Petrobras it is business as usual. Offshore drilling this year will again increase, as will seismic work. Deepwater drilling last year increased two and one-half times over the 1985 level and is expected to go even higher this year.

In analyzing the nation's aggressive exploration drive, it is important to point out Brazil is in desperate need to increase its reserves. Recoverable reserves today are estimated at 2.3 billion bbl, which based on the current production level of 600,000 b/d will be consumed in another decade. The government, therefore, has charged Petrobras with the responsibility of increasing those reserves on hand.

Petrobras has pinned most of its hopes in the extremely deep waters of the Campos Basin, off the coast of Rio de Janeiro. The basin, which has water depths ranging from 1,200 to more than 3,000 ft, today is responsible for 60% of the nation's total crude output. The Albacora and Marlim fields together are estimated to hold reserves that contain at least 2.5 billion bbl and could go much higher.



The discovery of such giants gives Brazil the potential to realistically double its reserves. However, the main problem is producing at such depths. Petrobras already holds the deepwater production record with the Campos well 1-RJS-282 that is situated in nearly 1,000 ft of water.

A total of seven fixed production platforms and 11 floating systems are presently linked to more than 60 isolated and clustered subsea completions with wet Christmas trees. Total national production this year will probably maintain the 600,000 b/d level first reached last year and of this, 430,000 b/d will come from the offshore sector.

Since the first Campos find in 1974 at the Garoupa field, Petrobras has sunk more than $7 billion into the offshore arena. Beginning this year and continuing through 1989, the state company will pour another $1 billion into the Campos to develop the northeastern pole, an area where six fixed production platforms are under construction.

Drawing mainly from the Vermelho field, where three platforms will be placed, Petrobras expects to bring on stream another 95,000 b/d within two years. That level would raise national production to 700,000 b/d.

While the Campos has been the center of attention offshore Brazil, surrounding areas also hold promise.

"The high productivity of their (Campos Basin) wells has raised the exploratory interest of the deepwater plays of other Brazilian offshore basins," says Wagner Freire, Petrobras' director of exploration and production.

Indeed, exploratory drilling and seismic exploration have identified no less than seven highly promising deepwater basins outside the Campos. Those include the Jequitinhona Basin, the Sergipe/Alahoas Basin, the Espirito Santo Basin, the Santos Basin, the Foz do Amazonas Basin, the Para-Maranhao Basin and the Portiguar and Ceara Basins.

The Santos Basin, for instance, is just south of the Campos and is said to have the same geologic conditions as its prolific neighbor. Petrobras intends to undertake seismic surveys in the basin aimed at identifying gas prospects similar to the discovery made by Shell/Pecten in the Merluza field. Additionally, in early 1987, the drillship Pacnorse 1 was drilling the 1-BAS-80 wildcat in 3,116 ft of water. The exploratory well is located in the deepest water depths ever penetrated outside the Campos Basin.

While seismic survey results outside the Campos have been extremely encouraging, Freire cautioned that exploratory activities will continue to feature the basin in the foreseeable future. The state company is intent in defining new prospects similar to those of Albacora, Marlim and Marimba.

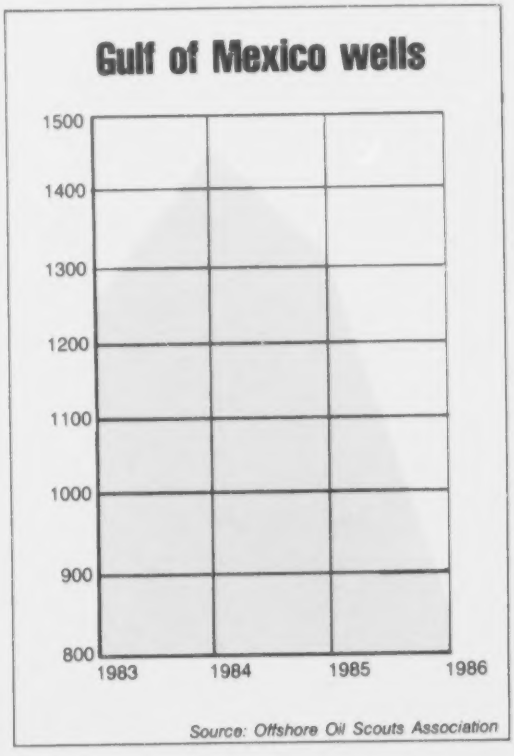
"With the exploration activities, Petrobras will simultaneously intensify research and development studies related to deepwater production systems to overcome the technological challenges to install them as soon as possible," he explains. "The company's effort to subdue the technological difficulties is being achieved through multi-client projects with the participation of operating companies and engineering companies, agreements with international research centers and by developing our own research."

Another encouraging result from Campos exploration activity is the amount of non-associated gas being discovered there. Both the Marlim and Albacora fields, for instance, have been found to contain large gas reserves. Petrobras estimates Albacora may contain 100 to 150 billion cu meters and Marlim is believed to hold 100 billion cu meters.

Taking the high estimate for Albacora would add 250 billion cu meters of gas reserves to the nation's present total of 93 billion. Today Brazil is producing 16 million cu meters per day with 2.5 million cu meters reinjected and 3 million cu meters flared. Production was up 16% last year and Petrobras is continuing a policy to reduce flaring which it hopes will be down to 2 million cu meters per day this year.

The only other area in South America drawing international attention is the southern tip of Argentina. French operator Total in early 1987 said it is making plans to develop its Hidra find.

Elsewhere, in the western hemisphere, the present operating conditions are not as encouraging. The Gulf of Mexico, which was once the world's most prolific producing sector, is presently facing the brunt of the depression in the petroleum industry. Nevertheless, some bright spots are appearing on the horizon.



For instance, John H. Lollar III, president of Transco Exploration Co. of Houston, referring to low well costs in the Gulf said in February that operating conditions in the theater were "wonderful." At the same time, he said his company would spend $80 million of its $120 million exploration budget in the Gulf of Mexico, primarily to test leases with a mid-1988 expiration date.

Ronald C. Lassiter, president of drilling contractor Zapata Corp., added in early 1987 that inquiries for rigs were increasing. He said his company has received a "flurry of information requests" for semisubmersibles since the first of the year.

Some Gulf watchers believe that operators will swarm in the sector this year to take advantage of low rates for rigs and associated services to drill their holdings before they must be turned back to the federal government.

Many of the leases currently held in the Gulf have been acquired since areawide leasing began in May 1983. A total of 2,734 tracts have been leased, with 615 drilled as of mid-1986.

In 1983, there were 623 tracts leased in OCS Lease Sale 72 in the central Gulf and 406 tracts were awarded in the western sale later that year. These tracts will begin to expire in the third quarter of 1988, if not held by production of the OCS Order 4.

Only 36 tracts from OCS Lease Sales 72 and 74 are located in deep water, which means they hold 10-year leases. OCS Order 4 provided for extending leases beyond their primary term as long as gas or oil may be produced from a lease in paying quantities. This can be demonstrated by production tests or with well logs showing a minimum of 15 ft of producible sand in one section that does not include any interval which appears to be water saturated.

Major operators and independents in the Gulf with a large amount of acreage under lease face some heavy decisions in the very near future. Many are now drilling their high-potential acreage and farming out the less-attractive holdings.

The large and medium independents were aggressive in the Gulf last year and most say they will continue their offshore programs this year. The majority say they have 1987 exploration budgets that are very similar to 1986, providing the oil prices hold.

In the meantime, however, there appears to be little interest in acquiring new acreage in the Gulf, meaning more and more farmouts will be the norm. Instead of participating heavily in future lease sales, the independents will be seeking farm-out opportunities while majors evaluate their soon-to-expire lease holdings. When drilling is undertaken, the primary target will be the giant fields.

Most of the attention in the Gulf, however, has been geared toward the massive Placid Oil Co. production scheme for the deepwater Green Canyon Block 29. The field is sitting in 1,560 ft of water.

Financially strapped Placid in early 1987 was attempting to generate enough funds to keep its unprecedented floating production system alive. All of the components by early 1987 were ready for installation, with the exception of conversion of the drilling vessel Penrod 72.

The production system, which will be a first in the Gulf, is expected to handle up to 40,000 b/d of oil and 120 MMcfd of natural gas.

Throughout the U.S., two-thirds of the major discoveries, which means those fields holding reserves of 100 million bbl of oil and 150 Bcf of gas, have been found offshore. While the prospects for smaller reserves have not diminished, the geographical choices offshore have dwindled in the past six years. California, where long delays and environmental problems extend development periods, now looms as the only known remaining area to find fields with medium and large reserve volumes.

Unless some deepwater exploration results in significant oil discoveries, the Gulf of Mexico will rapidly become a gas-only province. Elsewhere, Alaska's western and southern basins have resulted in little success with the only hope being the Beaufort Sea and North Slope. Those projects, however, must wait until crude prices rise sufficiently to justify the extremely expensive programs.

The U.S. Atlantic has some potential but the costs of a focused search program are beyond what the industry can now afford. All the wells drilled to date on the U.S. northeastern coast have been dry, but some experts say an extended drilling program could reap rewards.

The size of new offshore oil fields now averages about 10 to 20 million bbl. The size peaked in 1978 at 20 to 30 million bbl, surged briefly in 1983 with the advent of areawide leasing and has declined ever since. However, most operators agree the offshore sector holds most of the promise in the U.S.

"The offshore is still the only viable area for any significant number of 500 million bbl field and those are only off California and Alaska," claims an internal Placid Oil Co. report on the location of potentially giant fields in the U.S.

The prospect of finding giant reserves outside of those two sectors is dim, the report added. "The Atlantic area may be gas prone and geochemically too cool for the generation of great volumes of oil. The Gulf of Mexico is constrained by the nature of reservoir continuity for fields no larger than about 200 million bbl," the report indicated.

On the other hand, the report adds: "The Monterey Formation in California is widely distributed offshore and it is the source as well as the reservoir for almost all of the major fields in California."

A joint industry study by the American Petroleum Institute, the National Ocean Industries Association and the Western Oil and Gas Association last year reinforced that view. "The Los Angeles basin is the world's most productive reservoir, holding as much as 13 times that of the Persian Gulf or the Gulf of Mexico."

Six giant fields, containing more than 200 million bbl each, have been found off California in the past 15 years. All of the discoveries off California in the 15-year period hold a total of 2 billion bbl of oil.

However, despite its enormous potential, the California offshore basin remains relatively unexplored. A total of 564 wells have been drilled in the OCS area and another 3,650 wells have been drilled in state waters in the state's exploration history.

By comparison more than 130,000 wells have been drilled onshore California. Some industry analysts have said natural oil seepage alone produces 278,000 bbl off California.

The biggest reason for the relative lack of exploration activity off California is environmentalists' successful efforts to lock up promising tracts. Only 369 tracts to date have been leased off southern California and of that number 137 have actually been drilled. Nineteen production platforms are in place on 16 tracts.

Farther to the north, the enthusiasm generated by a potentially giant find in Canada's Beaufort Sea last year, waned significantly when oil prices collapsed. At the end of 1986, Canadian exploration activity was at its lowest level in 40 years.

Gulf Canada early last year was lauding its Amauligak find in the Beaufort, which was originally tapped at having 700 to 800 million bbl of oil. The company, however, has placed all development plans on hold until oil prices firm.

To the east, the giant Hibernia structure also remains undeveloped and the near-term exploration prospects for the area remain slim. It has been estimated that two years may pass before this expensive high-risk sector becomes viable.

In the beginning of 1987, only three rigs were working the eastern region. Additionally, many companies announced they were pulling up stakes and leaving the region until it becomes more cost efficient.

Norway takes the lead as UK falters in North Sea

Bart Milner
International Editor, London, *Offshore*

After A decade of hectic expansion, the collapse of the price of oil has been a rude shock to the North Sea's industry. Rig utilization has fallen below 50%, with day rates barely covering break even. Some major contractors have gone into liquidation, and almost all have had to lay off staff.

The impact has been much worse in the UK than Norway. The UK has gone for the most rapid development it could manage, with fields brought on stream as quickly as possible and a huge injection of revenue and employment into the Scottish economy. An almost complete famine on new orders has hit the UK correspondingly hard.

Norway has opted for planned and phased developments, with the state and the state-owned national oil company Statoil supervising the politics and timing of every major new project. This has often irritated heavily taxed foreign operators, but the survival of Norway's long-term plans and the very gradual opening up of new territory is paying dividends now, as big projects disappear off the UK's drawing boards, and even the Netherlands with one of the world's most generous fiscal regimes has seen development fall by a third in one year.

Norway's position is very unusual for any developed country in the Eastern hemisphere. Like Texas or Trinidad, it is now an oil-based economy, with little other major areas of economic activity. Although the country, and its four million inhabitants must now stand or fall with the oil industry, Norway has maintained an enviable record of full employment and is striving to maintain this with as steady a development as a notoriously slump/boom industry will permit.

In common with the USSR and West Africa, but unlike the UK or the Gulf of Mexico, Norway still has potentially huge but untapped marine resources. A symbol of these long-term reserves is the Troll field, the largest undeveloped gas field known to exist, which also happens to be in the deepest water. While the rest of the industry has agonized over present and future barrel prices, Norske Shell, operator for the development phase of Troll, and a new generation of enthusiatic young Norwegian engineers and geologists, have been tackling the technical challenges of the field which will still be in peak production in the next century.

Norway backs OPEC

Norway's long-term future as an oil producer gives it an important stake in price stability. This has led to a rapprochement with OPEC, who asked for and got a 10% production cut from existing Norwegian fields, early in 1987. This again was in marked contrast to the UK, whose conservative government is firmly opposed in principle to OPEC's cartel powers of price fixing, but whose industry has been praying for the organization to maintain a high and steady barrel price. In both countries production was running at record levels in the first weeks of 1987, despite the glutted market.

Companies with large Norwegian revenues from current production have found the situation extremely uncomfortable. They stand to gain in the longer term from any strengthening of OPEC's effort to push up prices, but cuts in production mean an immediate loss of revenue, already halved last year in the price collapse. Phillips may have suffered most, with massive but unexpected expenditures on jacking up a large number of Ekofisk platforms subject to significant field subsidence. The field itself is in steady decline and further costs were incurred by the need to provide a large new, purpose-built water injection platform installed during 1986.

Prior to the production cut, Norway showed itself capable of fiscal flexibility by introducing a new tax regime which makes new field developments much more attractive, but which will have no effect on fields already producing or under development. Operators, such as BP or Elf who were in the process of completing projects planned under old taxes and old oil prices, felt that the concessions did not go far enough, but other operators were keen on the new tax system. The real fear of a dearth of new orders in the early 1990s has been set aside, for the moment at least.

The new frontier

Above Norway's 62nd parallel lies a new oil and gas province, probably the world's most significant new hydrocarbon frontier. It is in deep water and in an extremely harsh environment. Most of the reservoirs already discovered are gas prone, with relatively large reservoirs of white oil, overrich with the mid-fractions of natural gas liquids.

Potential technical problems are immense, and any rush to production is unlikely, since the industry is crude-heavy and cash-strapped while Statoil and the Norwegian Petroleum Directorate want a planned and logical development of the region's transportation infrastructure. This is bound to be expensive. But already two fields,

Shell's Draugen and Conoco's Heidrun, look very commercial and Conoco has been cheerfully researching the possibility of a second tension leg platform (tlp) in the North Sea. A senior Russian delegation led by the equivalent of the Energy minister has also been out to Conoco's Hutton tlp, and a license for export may be feasible after new trade agreements between the UK and the USSR, and the US lifting of certain trade embargoes against the Soviets.

Aker's floating production system (fps) has also edged off the drawing board with Norske Shell asking the company for conceptual studies of application on the 6407/9 Draugen field. Much of this conceptual work is done by Aker in London with Aker in Oslo undertaking a simultaneous conceptual study of a conventional platform in 600 ft of water.

Farther north and up into the arctic, the geology has only just been scratched with regional seismic and stratigraphic drilling on the geologically anomalous Svalbard Islands of Spitzbergen. But 1987 should see the licensing of up to five strategic blocks in the Barents Sea.

Geco, the Norwegian seismic company recently merged with Schlumberger, has been commissioned by Esso, Norsk Hydro and Statoil to carry out detailed seismic in the Barents Sea and North Cape basin. The Geco Sigma will be used for the first commercial mapping of the area following an initial survey undertaken by the Norwegian Petroleum Directorate.

Despite severe recession in the exploration industry, interest in the area is intense. Arco, which has never lost its frontier spirit, is one of the applicants for the block and is offering subsea and floating technology developed from the company's Alaskan experience. The aim is to produce from inexpensive facilities with a fair degree of weather sensitivity, rather than going for the massive, and massively expensive, ice resistant structures capable of year-round production.

Early production

Norway has tended to avoid floating production, since fields to the south have usually justified the expense of installing huge and very permanent concrete structures. Up until the end of last year, early production has only been used off Norway once, with a jackup subsea production system on Ekofisk when there was a fear that the chalk reservoir might be as tight as Denmark's extremely unproductive Dan field. In a different economic climate, there has been a swing back to cheaper ways of doing things, however, and Norsk Hydro is now using the custom-built turret-moored Petrojarl monohull for extended well testing/early production on Oseberg. Statoil is also now pressing ahead with a new field Vesselfrikk which will utilize a converted semisubmersible.

The Norwegians, despite closures and layoffs, still seem to be taking the slump in stride. Gullfaks, Statoil's first development operatorship produced first oil in February 1987. A new set of subsea satellites are being installed and the equally massive second phase of field development is on its way. Norsk Hydro is working away on the Oseberg field with up to three platforms planned, and one nearing completion. The small independent Saga, has fought off cash flow problems and the threat of mergers and is still keen to stick to its development schedule for Snorre, which will probably involve either floating production or possibly another tlp.

Shell is supervising the Norwegian-based research on deep, possibly diverless subsea production on Troll. Elf is going for advanced subsea production on East Frigg, after finding that pressure drop on the main Frigg reservoir may mean early abandonment. BP brought its three steel-jacket Ula field on stream, announced that it would not be making a profit and then cheerfully suggested a new development nearby, Gyda, which could prove profitable under the new tax regime.

Statoil has also gone forward with the subsea template for Tommelitten field, which will export gas through Ekofisk. A new joint venture, Aker Hughes in Stord has won the contract for five trees destined for the first phase of template development. The trees will be manufactured at Hughes facility in Montrose, Scotland.

Norwegians invest in subsea

The Norwegians are fascinated by the technical and commercial possibilities of future subsea production, and most new field plans reflect this. Mobil, having lost most of its staff in Norway when its development operatorship of Statfjord was taken over by Statoil for the fully operational phase, has been concentrating on the research and development of a Subsea atmospheric system for possible installation on one of Statfjord's deep outlying satellites. At the Norwegian Underwater Technology Center (NUTEC), Elf has been developing the modular principles of Skuld and now Super Skuld - template based, diverless remote production facilities, are advanced as any subsea project in the world.

The biggest boost to confidence and work levels in the North Sea has come from a more conventional source, Statoil's announcement of Zeepipe, a large new common carrier for gas from the Troll and Sleipner fields to be installed between southern Norwegian waters and a terminal on the Belgium coast. Final agreement on gas sales came only after considerable arguments with the French, who wanted work for French contractors in exchange for buying 40% of gas supplied from Troll and Sleipner. The Norwegians had already been through a similar argument with the UK government over Sleipner which led to postponement of field development a few years back. Pointing out that Norwegian content seldom exceeds 30% of any project, the Norwegians refused the French request and after lowering contract volumes slightly, the French finally agreed.

UK development on hold

Over in the UK sector, things have not been so constructive. With government encouragement for a rush to peak production wherever possible, the fall in the oil price has meant the loss of thousands of jobs. The UK's malaise actually predated the oil price chute. Like the Gulf of Mexico, with which the UK has very close ties, rapid development of available reservoirs ultimately hit a major contract famine when all the easily available large reservoirs had already been tapped. It was clear even in 1985 that large new orders were simply not coming up any more.

The truth is that the UK has at least three crops of fields, but is finding it very hard to adapt from the conditions which developed the second phase to that which will determine the success of the third.

First phase of development was the good, steady but unexciting gas fields of the southern North Sea, nicely balanced to feed a large but entirely domestic market with prices fixed by the then state-owned monopsony British Gas. Once these platforms were in place and producing, attention shifted very rapidly to the northern North Sea which contained a large number of reservoirs which were big by world standards and some of which, such as BP's Forties or Shell's Brent, were true giants. The geology of these fields proved very generous with record flow rates regularly reported. Despite long lead times and relatively huge project costs, the operators harvested this crop with a few unpleasant suprises, but very few failures and a high average real rate of return, after 1979 saw the UK government introduce a generous fiscal system as OPEC pushed prices up to $30 a barrel.

Most if not all of the UK's largest fields have now been discovered and developed, with only BP/Conoco's Miller field still waiting for development. The third wave of developments, much smaller pockets close to existing fields which can be tied into the vast pipe and platform infrastructure already installed in the North Sea, are currently waiting in the wings. Up to 90 such fields have been notified to the UK's Department of Energy.

Difficult transition

A smooth transition was too much to hope for however. The UK industry has grown used to megaprojects, when huge sums of money were spent freely, if not wastefully, to produce some of the world's largest and most impressive pieces of civil engineering.

The UK has frankly found it hard to adapt to strict cost accounting, tight common component engineering, and minimum expenditures. This entails more optimism about the long-term future of the industry than the industry can currrently muster when revenues are down by 50% and many operators have additional liquidity problems resulting from stock market predators. Even when $15 a bbl seems a reasonable bet for the mid-future, there is an acute confidence famine in all sectors of the industry.

Hardest hit have been the contractors, particularly on the marine supply and rig side, but the onshore fabricators have also fallen from grace with two of the leaders in domestic industry, Howard Doris who built jackets and Carron Hall who built modules, going into liquidation. ITM, which even worried the mighty Heerema company with its new monohull heavy lift vessel, also passed into the hands of a receiver in 1986.

With a few exceptions, both the European operators and most of the small independents were treading water, floundering or even drowning. Repeated requests for a better tax system where rejected by the UK Treasury, which felt that enough concessions had already been made during the good times. Shrewd lobbying by Sovereign, one of the most outgoing of the UK independents, did generate one tax concession, a delay on paying Advanced Petroleum Revenue Tax, which eased cash problems for a number of the smaller participants. Further concessions seem unlikely and despite government vulnerability in a possible election year, such proposals as have emerged from the opposition parties have seemed either irrelevant or impractical, with suggestions ranging from a ban on flags of convenience to imposition of work permits for foreign labor working offshore.

Protectionist support

Protectionism has reared its head again. While the UK's Department of Energy took pride in a UK content running at up to 80% of most projects, a new group, Mackay Consultants, has stirred the soup by suggesting that the figure is only 48% because official figures avoid taking account of foreign companies with bases in the UK. Excluding these companies, and including contract values under $150,000 with reference to actual orders rather than planned expenditure, Mackay disputes the Department of Energy's Offshore Supplies Office (OSO) figures and suggests that the UK content of drilling and appraisal is only 32% rather than the 67% claimed by the OSO. Mackay's figure for drilling tools and equipment is only 12% compared to the OSO's figure of 69% and transport is 26% against the OSO's 85% UK content.

The EEC and particularly the French have claimed and sometimes proved in the past that the UK market is already heavily protected in a way that may be contrary to EEC law. Mackay's survey is likely to increase the bitterness of the conflict without doing anything to increase the size of the market supplied.

More joint ventures

Large American contractors have found it expedient to go into joint ventures with UK companies. One of the most interesting recent partnerships was the establishment of Foster Wheeler Associates, a tieup between Foster Wheeler, Ferranti who lead the field in subsea control systems and the Wood Group, a large and diversified supplier from Aberdeen.

Brown and Root has also been looking for a suitable UK partner for some time. It has now

signed a letter of intent of merger with Vickers Design and Projects to form Brown and Root Vickers Ltd with net assets of $15 million. Brown and Root takes 70% of the equity and Vickers 30%.

Texaco points the way

As often happens in the UK sector, it is new ideas from the U.S. which are currently pointing to a new way forward. BP has put all developments on hold after installing a new unmanned satellite platform on South East Forties and seems content to reap good profits in the downstream sector after rationalization corrected years of losses. Shell is very heavily committed to old-style megaprojects on Tern and Eider but has had to let other parts of the complex such as Kittiwake go, despite vigorous cost cutting.

In 1986/87 it was down to Texaco to demonstrate the North Sea's vast potential for $5 investment oil. Texaco brought its new subsea Petronella field on stream at the same time as Occidental's large template-based Scapa project, but at a tiny fraction of the cost of most new fields.

Dr. Bill Doyle, president of Texaco UK, spelled out his company's philosophy of development. "The estimated cost of production from current (North Sea) construction is $18 a bbl. This is the estimated cost to operate amortize and provide a 10% real rate of return prior to tax and royalty. Clearly lower costs are needed to ensure the full development of the North Sea's resources. Previously set targets for 15% reduction in development costs is inadequate."

He continued, "This in turn means that only satellite developments using existing infrastructures are likely to proceed in the medium term. Even here there is a need for new cost reducing technology. This will mean an increasingly important role for subsea technology over the next few years and the priority must be on reducing costs and increasing reliability."

Dr Doyle does stress that Texaco has had very few reliability problems with their subsea satellites on both Tartan and the innovative Highlander scheme and suggests that a big source of future savings will come from the extension of common standards in the subsea industry. He also holds that the emphasis must shift from custom engineering every aspect of a North Sea project, back to catalog components, with the drawing board only used when absolutely essential.

New UK projects

New projects in the UK sector have been in short supply. The only really new application has been for Phillips' operatorship of the trillion cubic foot Audrey gas field. Phillips holds 65% from Block UK 49/11a and after unitization, Conoco and Britoil's 48/15a block has given them 35% of the field. Initial field development will be a single unmanned platform linked by a 10.5-mile, 20-in. diameter pipeline into Conoco's new Logs gas carrier line. Peak output of 450 million cu ft/d will come soon after startup in October 1988.

Three new UK gas fields have come on stream. Arco's Thames field came on stream ahead of schedule using early production through suspended appraisal wells and jacket installation over a template. Shell's two new $520 million Sean North and South gas fields were also ready for production in the fall. These are the first North Sea fields to be used for "peak shaving" — irregular winter supply of up to 600 million cu ft per day from reserves of 425 billion cu ft. A second phase of development will involve placing a compression platform on Sean South sometime after 1990.

BP and Conoco are proceeding with the southern Village and V block gas fields respectively. BGC's arguments during its attempts to buy Sleipner gas from Norway was that there would be a major shortfall in UK domestic gas supplies in the mid-1990s. A particularly cold snap in January saw the prediction coming true early, with production running at record levels, all interruptible supplies cut off, and some cut offs of domestic supplies in East Anglia.

British Gas was sold off on the Stock Exchange late in 1986, and should now be free in principle to return to buying gas from Norway without the British government being able to stop it. Problems with pressure maintenance in the Frigg reservoir make a link to Troll very likely.

UK civil contractors Costain's have reopened their plans for a proposed new North Sea gas gathering liquids line from BP's Bruce field and associated developments in the area. Liquids would be delivered to a new reception terminal and petrochemical works at Nigg Bay in Scotland. The $400 million, 24-in. line would be 275 miles long and would pass through fields with reserves of approximately 1.5 billion bbl. Costain was hoping to reach agreement with BP and other operators in the area by the middle of this year.

The relative significance of UK gas is indicated by the Edinburgh analysts, Wood MacKenzie, who expect only three major oil projects in the UK in the next two years. Subject to price sensitivity, Wood Mack thinks Shell's Kittiwake, Miller and Shell's Osprey will go ahead at a cost of just under $2.5 billion. The Scots anlysts expect five more southern gas fields to be given the go-ahead: Amethyst, Audrey, Barque, Clipper, Ravenspurn North and Welland, worth $3.26 billion.

Another UK oil field which should come over the horizon is Amoco's Arbroath. Amoco won their long standing dispute with UK Den and Arbroath has been declared geologically distinct from Amoco's nearby Montrose field. Amoco was very pleased about finally having their large technical documentation accepted, since a geological separation makes Arbroath liable to major tax advantages. An Annex B development application was expected in the first few months of 1987.

Major new finds

Chevron has been testing UK 16/26-7 and industry rumors were rife that this might be a major new oil find of perhaps 300 million bbl recoverable, linked to Premier's recent completion on UK 22/2 to the south of Chevron's well. Talk of a single huge field may underestimate the extreme

geological complexity of this area.

Ranger also had an excellent gas result on UK29/5b-4 which was tested at a rate of 54 million cu ft/d plus 4,500 b/d condensate. Three-dimensional seismic is expected to precede appraisal drilling.

SEABED

Production technology

Past, Present and Future

Although there have been more than 300 shallow water gas completions in the Canadian waters of Lake Erie during the 1940s and early 1950s, modern seabed production technology has its origins in the American effort to drill into the ocean floor.

This effort in 1952 endeavored to drill into the mantle of the earth from a ship in an experiment dubbed the MOHOLE project.

Using the impetus of this project, workers such as Ronald Geer's group from Shell Oil, and another at Union Oil led by A. J. Field, later took up the daring idea of drilling and completing a producing oil well on the ocean floor.

The outcome of this precursor engineering was CUSS I, a drillship conversion capable of drilling in soft sediments in 3,500 meter water depths; a wellhead which could be sited on the ocean floor; and the assurance of full well control with a submarine BOP connected to the surface by a jointed riser. By the end of the 1950s, enough technology and hardware had been assembled and tested to assure Shell Oil's management of reasonable success with the completion of its West Cameron 192 No. 7 well. This experimental completion is recognized by subsea historians as the benchmark origin for the hundreds of subsea completed wells which have followed.

A chart of the progress in subsea technology since 1961 would show examples of significant developments which have been retained and improved for contemporary deployment. Innovation in techniques and hardware design is still as energetic today as it was when the pioneers took up the challenge in the 1950s. As a result of this undying enthusiasm, the subsea industry's catalog is full of equipment to be employed in many different combinations; from full field development to single wells in hundreds of meters of water depth.

There have been four distinct time intervals in the evolution of seabed production technology. The first is characterized by operator-designed and manufactured equipment; the second by vendor-designed hardware; the third

Derrick Booth
Subsea Data

by large-scale and expensive development schemes; and the current epoch by realism and a reversion to operator-controlled designs and interfacing requirements

In the beginning, the operators who decided to pursue seabed production technology were faced with assembling equipment which had been designed for land use, then adapting it or inventing equipment that could work in a submarine environment. Local jobbing shops and established oil country vendors helped the operators build their early submarine equipment. This technology transfer from land to low volume seabed wells was generally successful, and it encouraged the operators to continue.

During the second evolutionary period, operators were relieved of the task of full design and engineering responsibilities as vendors seized the commercial opportunities presented to them by the new market. The vendors extrapolated their earlier experiences as contractors and produced mainly untried catalog options of major components, such as wellheads, riser bases, connectors, trees, actuators and controls. Products of variable quality, most of them lacking cross-manufacture interfacing, negated the perceived advantages of a wide choice and the opportunity for competitive bidding on similar products. As a result, operators became less inclined to conduct R&D with untried vendors' products on subsea wells intended for commercial production.

All subsea completion activity ceased for a while in the United States following severe seismic activity in the Santa Barbara Channel in 1968 and the development of subsea equipment then passed to the rough environment of the North Sea, and also to Brunei.

North Sea move

The move to the North Sea in 1971, with the concept of an early production scheme to complete four prolific subsea producers on Ekofisk, coupled with the dramatic rise in crude oil prices over the next three years, had a profound effect on operators, research institutions, venture capitalists and vendors.

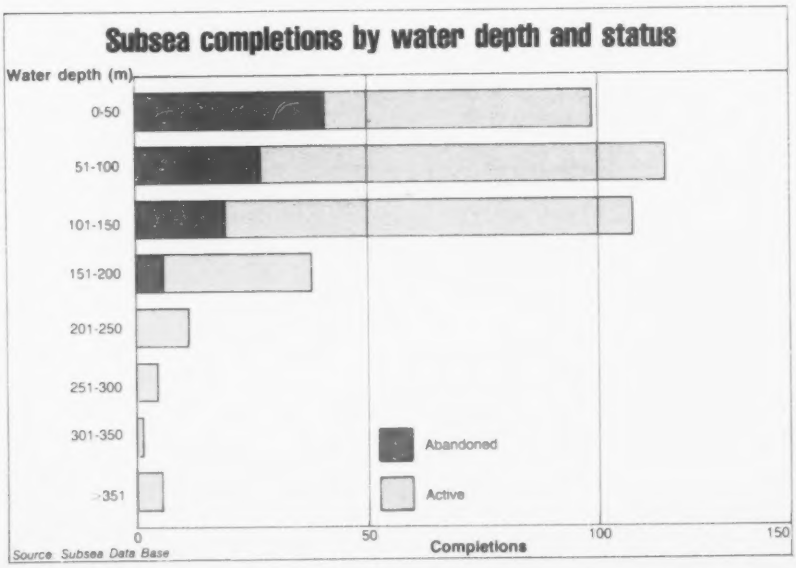
This period was also the heyday of large experimental installations by the leading operators; Elf's Northeast Grondin template, Exxon's Submerged Production System, and Shell/Esso's Underwater Manifold Center are examples.

Unfortunately, the period ended in some confusion and disappointment, with operators becoming aloof from vendors and their catalog equipment. As a result, venture capital for further subsea product development dried up for the lack of sales opportunities. The situation was aggravated by the seemingly endless discoveries of giant fields in the North Sea, all of which could be accessed from conventional platforms in relatively shallow water.

The current period of realism can be identified by the emergence of highly skilled independent consultancy groups specializing in seabed production technology, as well as in-house subsea engineering departments in the large international oil companies. These two powerful resources have returned the design and engineering initiative to any operator which shows a preference for seabed production methods, while vendors are now assigned to the detailed design and manufacture of speciality components.

Greatly improved quality assurance, quality control and interfacing considerations, as well as specific design concepts to suit specific field developments, are other characteristics of the age of realism, which is still evolving. However, each development continues to be of a prototype nature, and any cost savings which might be achieved through commonality and scale continue to elude the cost-conscious operators.

But the four periods have produced two clearly defined development options: single or multiple satellite wells producing to a fixed or floating production platform; and the multiwell template provided with a subsea manifold for commingling production.



West Cameron 192

The original West Cameron 192 No. 7 completion, was not only the first subsea well completed on the U.S. Outer Continental Shelf (in 17 meters of water), but it was also the first example of pump-down technology or through flowline (TFL) techniques to allow the tubing string to be entered without the intervention of a mobile offshore drilling unit. This completion also used sequentially-activated hydraulic controls for valve functions, and it was drilled and completed by the world's first semisubmersible rig, Bluewater I, originally a bottom sitting submersible. These features took years of development to make them reliable.

West Cameron 192 No. 7 led in 1962 to the first full field installation

with 20 satellite completions. The Texaco Conception field development off California set a still unbroken record for the number of wells in any one field. Conception was also the site of the first gas-lifted and multiple-zone subsea completions.

A large gas field discovered off Ventura in 1959 was the spur for the Shell subsea group to become creative. The group argued that while a 75- meter water depth was workable with air-breathing divers, the opportunity to develop a robot-installed tree and flowline was justified. Out of the project came MOBOT, the first remotely operated vehicle, the first lock-down wellhead with concentric annulus access, the first composite production tree with all valve functions in a monoblock, and the first integral direct hydraulic control with an umbilical laid directly ashore.

A hurricane severely damaged a production platform on Eugene Island block 176 in the Gulf of Mexico, and in 1966, Sinclair Oil (now Arco) restored production from the field with the first multiple zone subsea completion using TFL. Chevron, meanwhile, installed a multi-well subsea template on the West Coast. In 1969, BP and Total followed with trials on a well off Abu Dhabi. Zakum ZK-39 had a subsea separator, a subsea nuclear power source, and the flowline was armored and flexible.

Ekofisk completions

The first subsea completions in the North Sea were made by Phillips on four appraisal wells in the Ekofisk field. It was the first example of an early production system on a jackup drilling rig in advance of permanent field development. When activity returned to the Gulf of Mexico it was again Shell Oil with Main Pass 290 No. 13. This was the first one-atmosphere dry cellar completion.

The first oil from the UK shelf of the North Sea was from Hamilton Brothers Argyll field. It was developed by the original floating production facility, which had be constructed from a converted semisubmersible. A parallel development by Shell International and Single Buoy Moorings in 1977 was the concept of a ship-shaped floating production storage and offloading unit (FPSO), moored over the Castellon field by a single anchor leg mooring (SALM).

The first subsea completions in the North Sea were made by Phillips on four appraisal wells in the Ekofisk field. It was the first example of an early production system on a jackup drilling rig in advance of permanent field development.

All these pioneers held a vision of producing offshore wells without the need for conventional platforms as the operators of the day pressed hard to follow onshore trends under the ocean. Platform technology merely transferred land-based technology to a marine environment in the shortest possible time.

Platform technology was capable of development to at least 300 meters without any fundamental change in the design of completions, christmas trees, separators and other production equipment.

Subsea production equipment, on the other hand, was totally immersed in seawater. It was subjected to the effects of hydrostatic pressures externally as well as pressures from produced fluids internally. It could not be easily controlled manually and access to the wellbore created a number of problems. The produced fluids had to be conveyed by flowline from the wellhead to a platform or beach. Constructing, laying, and connecting flowlines was a difficult and expensive task which was not required with platform technology.

After Texaco's first full field development on the Conception prospect, it was more than a decade before the idea was employed again. But, subsea production eventually got its foothold because of the shortcomings of platform technology. Practical field drainage with the minimum number of jackets often left isolated reserves, and the use of subsea completions tied back to the platform were able to recover these valuable assets.

In 1971 there was a profound change in the perceived use of subsea completions when Phillips converted a discovery, and three appraisal wells into an early production system. Four wells were produced to a jackup that was put to work in the shortest possible time as a temporary production platform. The arrangement generated cash flow in advance of the conventional platform development. This unorthodox method of developing a discovery was used again on Argyll, eventually spreading to the Campos Basin off Brazil and other worldwide developments.

Early production

If the concept of early production and floating production systems had not emerged, it must be assumed the progress of subsea completions technology over the past 25 years would have been unremarkable.

The objective of subsea production technology in 1986 remains the same as it was in 1961: To produce oil and gas from under the ocean without the use of platforms. Except in a few instances where wells are producing directly ashore, the objective has not been realized and platforms are still required to support the surface production train.

In the following years, there have been refinements in equipment and an increase in the range of available options. Seabed production technology has emerged with a considerable advantage over bottom-supported surface production technology. Flexibility in the choice of options available before the development plan is finalized make subsea production methods superior to fixed platform technology in almost any field-by-field study.

Re-arranging systems

Re-arrangement of subsea production systems have taken place to optimize Argyll, Enchova (now Bonito), and Garoupa/Namorado. Bonito has been re-arranged five times and Garoupa three times before its abandonment, when two former one-atmosphere wellheads were converted to

wet completions and tied back to the Garoupa platform.

Argyll's floating production equipment has been re-assigned to another field and an upgraded FPF has taken its place, processing the export from the new field in addition to uplift from Argyll and Duncan. Argyll-/Duncan as well as Buchan have been upgraded with gas lifted wells. This enhancement was accomplished with the minimum amount of downtime and resulted in increased production.

Many options have been opened by the use of subsea production techniques which are either closed or uneconomical with fixed platform extraction methods. For instance, a successful completion has already been made in 383 meters of water, and more are planned in 400, 800 and 900 meters water depth. Subsea completions also are planned for shallow wells in deep water, and suspended, deep discovery wells in shallow water depth will also be produced by ship-shaped equipment which can steam to a port of opportunity when its tanks are full.

Subsea production to a floating system lends itself to deployment in countries where the political regime is unstable and sequestration of assets is a constant threat.

Seabed production technology has emerged with a large advantage over bottom-supported surface production technology. Flexibility in the choice of options available before the development plan is finalized make subsea production methods superior to fixed platform technology in almost any field-by-field study.

Only 366 completions

If subsea production technology is so attractive, many are inclined to ask why there have been only 366 completions throughout more than a quarter of a century of activity. The short answer must be that the original vision of offshore production without the need for conventional platforms has not yet been realized. Other objectionable features are the complexity and precision demanded by all units of the subsea system.

Current worldwide production by subsea methods is minute when compared with the quantities lifted by conventional means. It hovers around 500,000 b/d and about 260,000 b/d is being lifted in the Campos Basin by Petrobras. This level of production can be compared against an average of 2.24 million b/d lifted in the North Sea during August 1985. This figure includes about 110,000 b/d contributed by subsea completions.

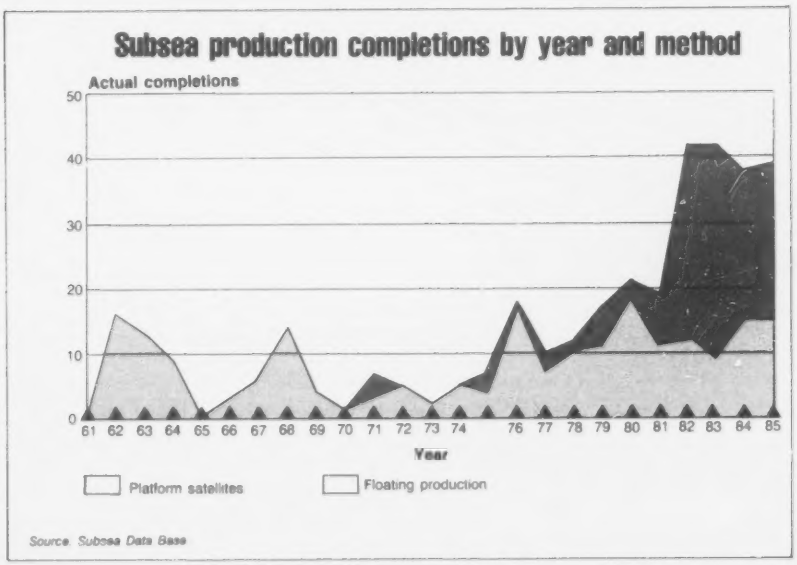
The most complex subsea production system built to date is the Central Cormorant underwater manifold center in the North Sea. The estimated total project cost to full development in 1983 dollars was put at $558 million. The project has five production wells, counting the satellite P.1, and three injectors producing around 43,000 b/d. The field could have been produced by one conventional platform at a more economical cost, but UMC was originally a research and development project.

After the UMC specifications set new standards in underwater engineering, the cleanliness of most hydraulic control systems is now superior to many aerospace requirements, and systems redundancy equates with military equipment construction. These very high standards have drawn criticism from some cost-conscious operators, but there is no doubt that reliability standards for control systems have risen dramatically in the last three years.

At the other end of the scale, 1-RJS-284 producing 3,500 b/d from the Marimba field in nearly 400 meters of water has cost Petrobras around $22 million for initial capital expenditure. Had subsea production technology not been available, Marimba could not have been produced at all. Petrobras is now writing the book on subsea operations. Its difficulties are mostly related to the unsuitability of contemporary methods for drilling and completion operations from floating vessels in a Brazilian offshore environment, not subsea production equipment design and manufacturing problems.

Worry over accidents

There is a lingering apprehension on the part of some operating companies about the possibility of an uncontrolled leak or blowout with a subsea production system. How can a deep-water template well be killed safely,



and in the shortest possible time? How would an arctic completion leaking under winter ice be tamed before its fluids had migrated for thousands of square miles, completely beyond containment by any spill control methods available in 1986?

The trends for the immediate future of seabed production technology all indicate refinement and adaptation of techniques already available rather than any immediate realization of the pioneers' original vision. Techniques will be developed which do not materially reduce costs, but allow confident advancement to deeper water, or provide better economics for overall field development.

Other trends are emerging which promise to reduce maintenance costs for subsea equipment. There is research into the workover-free subsea completion, removal and replacement of critical modules by dedicated work systems or ROVs, and remedial wireline work in deep water from diving support vessels and other equipment which can be mobilized in the shortest possible time and having day rates substantially lower than semi-submersible drilling rigs.

Petrobras has turned back the clock to an early Chevron idea first tried on Gaviota 401, which was completed on top of an underwater mast to bring the tree to diver depth. The national company is proposing to set a submarine platform at great depths so the template on which the wells will be completed is at around 400 meters – the maximum depth possible for diver intervention.

On the other hand, a radically new development in Norway provides cause for considerable optimism. The project will not only reduce costs, but they could put platform extraction methods in a very unfavorable light. Most promising of all the claims for the Poseidon project is the final realization of the early vision — no nearby surface support for treatment of the produced fluids.

Poseidon requires only two new tools to be added to the inventory of proven subsea equipment: A high-powered, large volume submerged electrical pump, and long-distance transportation of the wellbore fluids through a pipeline in multiphase flow.

Poseidon requires only two new tools to be added to the inventory of proven subsea equipment: A high-powered, large volume submerged electrical pump, and long-dis tance transportation of the wellbore fluids through a pipeline in multiphase flow.

The system uses either template-mounted or satellite subsea completions connected to a central manifold and collection station. At the station is an electrical pump capable of handling two-phase flow. From the subsea station, there is a pipeline laid directly ashore—up to 200 km range is claimed to be possible—where the landed hydrocarbons are treated. The gas can either be sold or used in a power station to provide the remote pump with power by way of a submarine cable.

Prototype trials are contemplated on a 4,000 ton/day low speed pump, and a 8,000 rev/min high speed version is under consideration. Two-phase flow phenomena has been under study for some years, and computer modelling for dynamic simulation has already been developed. The model can describe start-up and shut-down situations, unstable flow conditions, up-hill and down-hill slugging phenomena, and erratic distribution of the liquid phase in transmission.

Author

Derrick Booth is a graduate of Chesterfield Technical College in England. He became an oil industry technical journalist in 1963 and in 1970 began specializing in seabed production technology. In 1980, he emigrated to Houston and set up Subsea Data Services, an independent research consultancy devoted to subsea production activity. In the early 1980s he promoted the creation of Subsea Data Base, a proprietary electronic record of all subsea completions and production systems.

Much more needs to be done on Poseidon before its potential claims can be put to test, but the equal partners, Institut Francais du Petrole, Statoil and Total, are determined to pursue their very promising proposition. The rewards, claim the partners, are:

- Much of the technology is already available.
- Subsea production is totally remote.
- No offshore manning.
- Produced gases are landed, not flared.
- Insensitivity to surface wind and wave.
- Substantially reduced field development costs.

The partners have so much confidence in Poseidon that three undeveloped oilfield profiles are being examined so implementation of the system can be anticipated when the decision to develop these fields is reached.

There is no doubt that subsea completions are assured of permanent and useful employment as an adjunct for the broader requirements of the offshore oil industry.

Early production and permanent floating production developments have greatly enhanced the standing of subsea completion technology, and provided the depletion of marginal reserves remains an economic objective, their popularity will continue to increase during the remainder of the 20th century and beyond.

If Poseidon lives up to its promise, the vision of the pioneers will be realized at last, and seabed production technology will be assured of a very lively future, competing on equal terms with traditional platform methods, or displacing them altogether.

Industry observers are watching Petrobras, working mostly alone, as it develops the deep waters of the Atlantic slope with hundreds of subsea completions. And if the price of crude oil again stabilizes at around the $20/bbl marker, there could be a revival of subsea production activity in other parts of the world where the water is deep, or the volume of reserves is too low to justify the use of conventional fixed platforms. □

COMPLETIONS SINCE 1960: A WORLD-WIDE REVIEW

OPERATOR / Province / Field name	Well number	Date	Water depth	Tree Manufacturer	Status
ADMA-OPCO					
Abu Dhabi					
Zakum	ZK-39	1969	21	Cameron	Abandoned
	ZK-116	1977	22	Cameron	Flowing
	ZK-136	1978	25	Cameron	Flowing
AGIP					
Sicily					
Emilio	No 3	1981	84	Cameron	Flowing
Lavinia	No 3	1982	83	Vetco	Flowing
Nilde	No 2	1980	94	Cameron	Flowing
	No 3	1983	105	Cameron	Abandoned
	No 4	1985	99	Cameron	Flowing
ALCORN INTERNATIONAL					
Philippines					
Cadiao	No 1A	1981	92	Cameron	Flowing
	No 3	1981	92	Cameron	Flowing
AMOCO					
Gulf of Mexico					
Eugene Isle 300	No 3	1983	61	FMC	Flowing
Gulf of Suez					
Shoab Ali	Plat. B	1974	27	Cameron	Closed-in
ATLANTIC RICHFIELD					
Gulf of Mexico					
Eugene Isle 175	No 4-4D	1966	25	Cameron	Abandoned
	No 5-5D	1966	25	Cameron	Abandoned
	No 6-6D	1967	25	Cameron	Abandoned
	No 8-8D	1967	25	Cameron	Abandoned
	No 9-9D	1968	25	Cameron	Abandoned
	No 11-11D	1968	25	Cameron	Abandoned
	No 12-12D	1968	25	Cameron	Abandoned
	No 13-13D	1969	25	Cameron	Abandoned
North Sea					
Bure	UK 49/28-1	—	33	FMC	Suspended
Yare	UK 49/28-13	—	33	FMC	Suspended
US West coast					
Coal Oil Point	308 No 2	1964	67	Vetco	Abandoned
	308 No 3	1964	67	Vetco	Abandoned
	308 No 4	1964	67	Vetco	Abandoned
PRC 2793	Allegria No 1	1964	67	Vetco	Closed-in
BROKEN HILL PROPRIETARY					
Australia					
Jabiru	No. 1A	1986	42	Cameron	Flowing
BRITISH PETROLEUM					
North Sea					
Buchan	B4 UK 20/5A-1	1982	121	Cameron	Flowing
	B6 UK 21/1A-2ST	1981	116	Cameron	Flowing
	B1 UK 21/1A-6	1981	116	Cameron	Flowing
	B2 UK 21/1A-7ST	1981	116	Cameron	Flowing
	B8 UK 21/1A-8	1982	117	National	Flowing
	B3 UK 21/1A-9	1981	116	Cameron	Flowing
	B7 UK 21/1A-10	1981	118	Cameron	Flowing
	B5 UK 21/1A-11	1981	116	Cameron	Flowing
Magnus	D6 UK 211/7A-3	1983	180	Cameron	Flowing
	EX-D8 UK 211/12A-3	1983	185	Cameron	Abandoned
	D3 UK 211/12A-5	1983	188	Cameron	Flowing
	D9 UK 211/12A-6	1983	184	Cameron	Flowing
	D4 UK 211/12A-10	1983	180	Cameron	Flowing
	D5 UK 211/12A-11	1983	183	Cameron	Flowing
	D7 UK 211/12A-12	1983	183	Cameron	Flowing
	D8 UK 211/12A-13	1984	185	Cameron	Flowing
CHEVRON					
Gulf of Mexico					
South Timbalier 176UC	No 1	1976	43	Vetco	Flowing
North Sea					
Ninian	UK 3/3-5A	1979	140	Hughes	Abandoned
Spain (Mediterranean)					
Montanazo	D-4	—	754	Hughes	Abandoned
US West coast					
Caliente	No 1	1962	71	W-K-M	Closed-in
	No 2	1964	75	W-K-M	Abandoned
Gaviota	No 201	1962	70	W-K-M	Closed-in
	No 401	1962	72	W-K-M	Closed-in
Summerland	SHSS No 51	1967	18	Vetco	Closed-in
	SHSS No 53	1967	18	Vetco	Closed-in
CHINESE PETROLEUM CORP					
Taiwan					
CBK field	CBK-4	—	55	Vetco	Flowing
	CBK-11	—	55	Vetco	Flowing
	CBK-11-1	—	55	Vetco	Flowing
	CBK-12	—	55	Vetco	Flowing
	CBK-12-1	—	55	Vetco	Flowing
	CBK-13	—	55	Vetco	Flowing
	CBK-14	—	55	Vetco	Flowing
	CBK-15	—	55	Vetco	Flowing
	CBK-16	—	55	Vetco	Flowing
CONOCO					
Gulf of Mexico					
Grand Isle 32	No 3	1980	27	Cameron	Flowing
Grand Isle 41	No 4	1978	30	Cameron	Flowing
	No 5	1978	30	Cameron	Flowing
	No 6	1978	27	Cameron	Closed-in
Grand Isle 43	No 4	1978	34	Cameron	Flowing
Grand Isle 47	No 3	1969	29	Cameron	Closed-in
	No 4	1978	30	Cameron	Flowing
W Cameron 459	No 3	1985	42	FMC	Flowing
Indonesia					
Kepiting	No 1	1986	91	FMC	Flowing
North Sea					
Murchison	UK 211/19-MS2	1978	155	Cameron	Closed-in
	UK 211/19-MS3	1980	155	Cameron	Abandoned
	UK 211/19-MS4	1980	155	Cameron	Flowing
ELF AQUITAINE					
Gabon					
Anguille	AGM 7	1968	31	National	Abandoned
N E Grondin	No 1	1976	58	Elf	Abandoned
	No 2	1977	58	Elf	Closed-in
	No 3	1978	58	Elf	Closed-in
North Sea					
N E Frigg	N 25/1B-2	1983	100	Cameron	Flowing
	N 25/1B-3	1983	100	Cameron	Flowing
	N 25/1B-4	1984	100	Cameron	Flowing
	N 25/1B-5	1983	100	Cameron	Flowing
	N 25/1B-6	1984	100	Cameron	Flowing
	N 25/1B-7	1984	100	Cameron	Flowing
Tunisia					
Ashtart	No 23	1984	67	Cameron	Flowing
	No 24	1984	67	Cameron	Flowing
EXXON					
Australia					
Cobia	No 2	1979	76	Cameron	Abandoned
Gulf of Mexico					
Grand Isle 803	U No 3	1964	18	McEvoy	Abandoned
	U No 4	1967	18	Cameron	Abandoned
West Delta 73	G-1084/2	1976	52	Vetco	Abandoned
	G-1084/3	1976	52	Vetco	Abandoned
	G-1084/4	1976	52	Vetco	Abandoned
HAMILTON BROTHERS					
North Sea					
Argyll	UK 30/24-2	1975	76	National	Abandoned
	UK 30/24-3	1976	76	National	Abandoned
	UK 30/24-5	1975	76	National	Flowing
	UK 30/24-6	1975	76	National	Closed-in
	UK 30/24-8	1977	76	National	Abandoned
	UK 30/24-9	1978	76	National	Flowing
	UK 30/24-10	1979	76	National	Abandoned
	UK 30/24-11	1979	76	National	Flowing
	UK 30/24-12	1980	76	National	Closed-in
	UK 30/24-14	1980	76	National	Closed-in
	UK 30/24-16	1982	76	Cameron	Flowing
	UK 30/24-18	1982	76	National	Flowing
	UK 30/24-20	1982	76	National	Closed-in
	UK 30/24-25	1983	79	National	Flowing
	UK 30/24-26	—	79	None	Suspended
	UK 30/24-28	1984	79	National	Flowing
	UK 30/24-31	—	79	None	Suspended
	UK 30/25A-2	—	79	None	Suspended
Duncan	UK 30/24-15	1982	76	National	Flowing
	UK 30/24-17	1983	76	National	Flowing
	UK 30/24-19	1983	76	National	Flowing
	UK 30/24-21	1985	79	National	Flowing
	UK 30/24-22	1983	79	National	Flowing
	UK 30/24-29	1985	79	National	Flowing
	UK 30/24-30	1985	79	National	Flowing
E Duncan	UK 30/24-23	—	79	None	Suspended
Innes	UK 30/24-24	1985	79	National	Flowing
	UK 30/24-32	1985	79	National	Flowing
HISPANOIL					
Spain (Mediterranean)					
Casablanca	CASA 1A	1979	134	Hughes	Abandoned
	CASA 6	1980	134	Hughes	Flowing

OPERATOR / Province / Field name	Well number	Date	Water depth	Tree Manufacturer	Status
	CASA 12	1984	135	Hughes	Flowing
	CASA 14	—	426	Hughes	Abandoned
Dorada	No E4	1979	93	Hughes	Abandoned
	No E5	1979	93	Hughes	Abandoned
	No E7	1979	93	Hughes	Abandoned
Salmonete	No 1	1986	108	BOP	Flowing
HYDROCARBONS (GB)					
Irish Sea					
Morecambe	UK 110/2A-7	1983	30	McEvoy	Closed-in
	UK 110/2A-8	1985	30	McEvoy	Closed-in
IMINOCO					
Iran					
Rakhsh	No 3	1971	64	Cameron	Closed-in
	No 5	1971	64	Cameron	Closed-in
	No 8	1972	64	Cameron	Closed-in
	No 9	1972	64	Cameron	Closed-in
	No 12	1977	24	Vetco	Closed-in
KERR McGEE					
Gulf of Mexico					
Ship Shoal 217	No 7	1968	34	Cameron	Abandoned
MESA PETROLEUM					
Gulf of Mexico					
Brazos A-7	No 4	1984	44	FMC	Flowing
W Delta 62	No 5	1984	41	FMC	Flowing
MOBIL					
Gulf of Mexico					
High Island 573	No 6	1980	109	Cameron	Flowing
Main Pass 293A	None	1973	77	Mobil	Abandoned
Vermillion 215	No 6	1978	38	National	Abandoned
North Sea					
Beryl	UK 9/13A-1	1979	119	SEAL	Closed-in
	UK 9/13A-6A	1978	119	Cameron	Flowing
	UK 9/13A-15	1979	119	Cameron	Flowing
	UK 9/13A-20	1980	118	Cameron	Flowing
OCCIDENTAL					
North Sea					
Claymore	UK 14/19-B1a	1982	112	National	Closed-in
	UK 14/19-B3	1983	112	National	Closed-in
	UK 14/19-14	1980	121	National	Flowing
	UK 14/19-16	1981	112	National	Closed-in
Scapa	UK 14/19-21	—	116	National	Flowing
S Claymore	UK 14/19-D1	—	108	National	Flowing
	UK 14/19-D2	—	108	National	Flowing
	UK 14/19-D3	—	108	National	Flowing
PANARCTIC					
Arctic Canada (Isles)					
Drake Island	F-76	1978	55	Hughes	Closed-in
PETROBRAS					
Campos Basin					
Albacora	1-RJS-297	—	433	None	Suspended
	1-RJS-305	—	476	None	Suspended
	1-RJS-316	—	654	None	Suspended
	1-RJS-328	—	516	None	Suspended
	1-RJS-335A	—	567	None	Suspended
	1-RJS-342	—	953	None	Suspended
	1-RJS-343	—	389	None	Suspended
Anequim	1-RJS-194	—	116	Vetco	Flowing
	3-RJS-217B	—	109	Hughes	Flowing
	3-RJS-218	—	110	None	Suspended
Badejo	7-BD-4-RJS	1981	96	TB	Flowing
	7-BD-6DA-RJS	1982	96	TB	Flowing
	7-BD-7D-RJS	1981	96	TB	Flowing
	7-BD-8-RJS	1982	88	Vetco	Abandoned
	7-BD-9D-RJS	1982	96	TB	Flowing
	7-BD-11A-RJS	1981	89	Vetco	Flowing
	4-RJS-258	1983	97	Hughes	Flowing
	7-BD-15-RJS	1985	100	FMC	Flowing
Bicudo	7-BI-1D-RJS	1981	124	Vetco	Flowing
	7-BI-2D-RJS	1982	132	FMC	Flowing
	3-BI-3-RJS	1983	209	Hughes	Flowing
	1-RJS-28A	1982	120	BOP	Flowing
	7-RJS-158D	1982	133	Hughes	Flowing
	3-BI-4-RJS	1983	194	Vetco	Flowing
	RJS-134	1982	124	Hughes	Abandoned
Bonito	7-BO-1D-RJS	1982	189	Vetco	Flowing
	3-BO-3-RJS	1983	208	Vetco	Flowing
	7-EN-7D-RJS	1982	189	Vetco	Flowing
	7-EN-8D-RJS	1982	189	Vetco	Flowing
	7-EN-9D-RJS	1982	189	Vetco	Flowing
	7-EN-10D-RJS	1982	189	Vetco	Flowing
	7-EN-11-RJSQL	1985	210	FMC	Flowing
	7-EN-14D-RJS	1982	189	Vetco	Flowing
	7-EN-6-RJS	1980	176	Vetco	Closed-in
	3-EN-1-RJS	1980	118	Vetco	Flowing

OPERATOR / Province / Field name	Well number	Date	Water depth	Tree Manufacturer	Status
	1-RJS-38	1979	189	Vetco	Flowing
	1-RJS-116	1985	297	Hughes	Flowing
Corvina	7-CO-1-RJS	1983	221	BOP	Flowing
	7-CO-2D-RJS	1983	225	Vetco	Flowing
	7-CO-3D-RJS	1983	225	Vetco	Flowing
	7-CO-4D-RJS	1983	225	Vetco	Flowing
	1-RJS-54	1983	264	Vetco	Flowing
Enchova	1-EN-1-RJS	1977	118	BOP	Abandoned
Enchova East	3-EN-4D-RJS	1979	110	BOP	Abandoned
Enchova West	RJS-22	1984	121	NA	Abandoned
Garoupa	1-GP-7-RJS	1980	124	Hughes	Flowing
	7-GP-8-RJS	1979	123	Hughes	Flowing
	3-NA-1A-RJS	1979	163	FMC	Abandoned
	3-NA-2-RJS	1980	151	FMC	Abandoned
	3-NA-3D-RJS	1980	160	FMC	Abandoned
	1-RJS-9A	1980	124	FMC	Abandoned
	1-RJS-19	1979	155	FMC	Abandoned
	GP-6	1977	120	None	Abandoned
Garoupinha	3-GP-1-RJS	1980	113	Vetco	Flowing
	3-GP-23-RJS	1984	115	BOP	Flowing
	GP-24D	1983	117	BOP	Abandoned
	3-RJS-213	1983	111	Hughes	Flowing
Linguado	4-RJS-139A	1982	103	CIW	Flowing
	4-RJS-49	1984	108	FMC	Flowing
	3-RJS-73B	1982	102	FMC	Flowing
	2-RJS-156	1984	96	FMC	Flowing
	RJS-157	1983	104	NA	Abandoned
	3-RJS-168	1983	104	National	Flowing
	3-LI-1-RJS	1983	103	FMC	Flowing
	3-LI-2-RJS	1984	100	FMC	Flowing
	3-LI-3-RJS	1985	101	FMC	Flowing
	3-LI-4-RJS	1985	108	Hughes	Closed-in
	3-LI-5-RJS	1984	124	FMC	Flowing
	3-LI-6-RJS	1985	101	FMC	Flowing
Marimba	1-RJS-284	1985	383	Hughes	Flowing
	1-RJS-293A	—	411	None	Suspended
	1-RJS-294	—	415	None	Suspended
Marlim	1-RJS-219A	—	853	None	Suspended
	1-RJS-319A	—	930	None	Suspended
	1-RJS-325	—	887	None	Suspended
N Garoupa	GP-17	1980	120	Vetco	Abandoned
	7-GP-21D-RJS	1980	125	Vetco	Abandoned
Namorado	3-NA-1A-6D-RJS	1985	210	Hughes	Flowing
	7-NA-11A-RJS	1985	224	Hughes	Flowing
	7-NA-21-RJS	—	232	Vetco	Flowing
Pampo	3-PM-2-RJS	1981	117	Vetco	Flowing
	3-PM-3A-RJS	1983	120	Vetco	Flowing
Parati	1-RJS-110	1983	106	Hughes	Abandoned
	3-RJS-162	1983	97	Hughes	Abandoned
	7-PA-1D-RJS	1983	97	FMC	Flowing
	1-RJS-180A	1983	95	FMC	Flowing
	7-PA-2D-RJS	1984	95	FMC	Flowing
Piranua	1-RJS-186A	1984	231	National	Flowing
	3-RJS-202D	1984	230	National	Flowing
	4-RJS-232	1983	293	National	Flowing
	4-RJS-216	1984	285	National	Flowing
	4-RJS-233	1984	243	FMC	Flowing
	3-PU-2-RJS	1984	307	Hughes	Flowing
	7-PU-6DA-RJS	1984	243	BOP	Flowing
RJS 25 Area	3-RJS-190	1985	173	FMC	Flowing
RJS 150 Area	3-RJS-150	1984	18	BOP	Flowing
RJS 294 Area	RJS-294	—	411	FMC	Suspended
RJS 314 Area	1-RJS-314	—	390	None	Suspended
Sul De Pampo	3-RJS-159	1982	114	Cameron	Flowing
	3-RJS-169D	1982	110	Cameron	Flowing
	3-RJS-170	1982	117	BOP	Flowing
Trilha	1-RJS-236B	1984	100	Hughes	Flowing
	4-RJS-253	1984	111	National	Flowing
	RJS-247	1984	100	BOP	Flowing
	RJS-265A	1984	100	FMC	Flowing
Viola	1-RJS-90	1985	126	Vetco	Flowing
	3-RJS-173D	1985	125	Vetco	Flowing
	3-RJS-174D	1985	125	Hughes	Flowing
	3-RJS-290D	1985	126	FMC	Flowing
	3-RJS-291	1985	125	Hughes	Flowing
	3-VLA-1A	—	129	Vetco	Flowing
Ceara Basin					
Espada	7-SP-5-CES	1983	36	FMC	Flowing
PHILLIPS					
Ivory Coast					
Espoir	A5-EDPP	1982	151	Hughes	Flowing
	A7-EDPP	1982	137	Hughes	Flowing
	A-9	1983	138	Hughes	Flowing
	A-10	1984	167	Hughes	Suspended
	C1-5 EDPP	1982	151	Hughes	Flowing
	C1-7 EDPP	1982	140	Hughes	Closed-in
	C1-8 EDPP	1982	111	Hughes	Abandoned
	C1-10	1984	112	Hughes	Flowing
North Sea					
Ekofisk	N 2/4-1AX	1971	70	National	Abandoned
	N 2/4-2X	1971	70	Vetco	Abandoned
	N 2/4-3X	1971	70	National	Abandoned
	N 2/4-4AX	1971	70	National	Abandoned

OPERATOR / Province / Field name	Well number	Date	Water depth	Tree Manufacturer	Status
N Hewett Area C	UK 48/30-8	1979	40	Cameron	Flowing
N Hewett Area B	UK 48/30-9	1979	40	Cameron	Flowing
US West coast					
PRC 2933	MOLINO No 1	1963	61	Vetco	Abandoned
	MOLINO No 2	1963	61	Vetco	Flowing
	MOLINO No 3	1963	61	Vetco	Flowing
	MOLINO No 4	1963	61	Vetco	Abandoned
	MOLINO No 7	1985	66	Vetco	Flowing
	MOLINO No 8	1985	67	Vetco	Flowing
PLACID					
Gulf of Mexico					
Ship Shoal 204	No 4	1968	35	FMC	Abandoned
North Sea					
NETH L-10	No 5	1974	29	Cameron	Abandoned
SELM (Montedison)					
Sicily					
Mila	No 4	1985	51	Vetco	Flowing
	No 5	1985	58	Vetco	Flowing
SHELL INTERNATIONAL					
Brunei					
Fairley	No 16	1974	55	Cameron	Flowing
SW Ampa	No 46	1968	22	Cameron	Abandoned
	No 48	1968	26	Cameron	Abandoned
	No 52	1968	26	Cameron	Abandoned
	No 163	1976	33	Cameron	Abandoned
	No 166	1976	40	Cameron	Abandoned
	No 168	1976	39	Cameron	Abandoned
	No 170	1976	35	Cameron	Abandoned
	No 221	1981	40	Cameron	Abandoned
Gulf of Mexico					
Eugene Isle 276	No 6	1977	45	Cameron	Flowing
Eugene Isle 330	No 4	1976	73	Vetco	Closed-in
	No 5	1976	73	Vetco	Closed-in
Main Pass 290	No 12	1970	103	Cameron	Abandoned
	No 13	1972	103	Vetco	Flowing
S Marsh I 73	No 5	1967	39	Cameron	Abandoned
Ship Shoal 274	No 1	1971	68	Cameron	Abandoned
	No 5	1975	64	Vetco	Abandoned
Vermilion 302	No 2	1977	60	FMC	Flowing
W Cameron 192	No 7	1961	17	Cameron	Abandoned
North Sea (With Exxon)					
Brent	UK 211/29-7	1976	142	Cameron	Abandoned
C Cormorant	UK 211/26-P1	1981	155	Vetco	Flowing
	UK 211/26-P2	1983	152	McEvoy	Flowing
	UK 211/26-P3	1983	152	McEvoy	Flowing
	UK 211/26-P4	1984	152	McEvoy	Flowing
	UK 211/26-P5	1985	156	Vetco	Flowing
	UK 211/26-W2	1984	152	McEvoy	Flowing
	UK 211/26-W3	1985	152	McEvoy	Flowing
Qatar					
Bul Hanine	A	1974	27	Cameron	Flowing
	B	1974	27	Cameron	Flowing
	C	1975	27	Cameron	Flowing
	D	1975	27	Cameron	Flowing
	E	1975	27	Cameron	Flowing
	F	1976	27	Cameron	Flowing
	G	1976	27	Cameron	Flowing
	H	1976	27	Cameron	Flowing
	I	1977	27	Cameron	Flowing
Idd El Shargi	No 1	1969	29	Cameron	Flowing
Maydan Mahzam	A	1968	35	Cameron	Flowing
	B	1968	35	Cameron	Flowing
	C	1968	35	Cameron	Flowing
	D	1968	35	Cameron	Flowing
	E	1968	35	Cameron	Flowing
	F	1968	35	Cameron	Flowing
	G	1968	35	Cameron	Flowing
Sarawak					
Baronia	No 4	1972	77	Cameron	Closed-in
	No 5	1973	74	Cameron	Closed-in
Spain (Mediterranean)					
Castellon	B-5	1977	118	Cameron	Abandoned
	B-8	1982	119	Cameron	Abandoned
	B-10	1984	120	Cameron	Abandoned
Tunisia					
Tazerka	No 5	1982	179	Vetco	Flowing
	No 8	1982	178	Vetco	Closed-in
	No 9	1982	149	Vetco	Flowing
	No 10	1982	152	Vetco	Flowing
	No 11	1985	160	Vetco	Flowing
US West coast					
PRC 2920	MOLINO No 1	—	73	Vetco	Abandoned
	MOLINO No 3	—	73	Vetco	Abandoned
	MOLINO No 2	—	73	Vetco	Abandoned
	MOLINO No 4	—	73	Vetco	Abandoned
	MOLINO No 5	—	73	Vetco	Closed-in
	MOLINO No 8	—	75	Vetco	Flowing
STATOIL					
North Sea					
Gullfaks	N 34/10-4	—	139	Cameron	Suspended
SUN OIL					
North Sea					
Balmoral	UK 16/21A-B1	—	141	Vetco	Suspended
	UK 16/21A-B2	—	141	Vetco	Suspended
	UK 16/21A-B3	—	141	Vetco	Suspended
	UK 16/21A-B4	—	141	Vetco	Suspended
	UK 16/21A-B5	—	141	Vetco	Suspended
	UK 16/21A-B6	—	141	Vetco	Suspended
	UK 16/21A-B7	—	141	Vetco	Suspended
	UK 16/21A-B12	—	141	Vetco	Suspended
	UK 16/21A-B14	—	141	Vetco	Suspended
	UK 16/21A-B8	—	141	Vetco	Suspended
	UK 16/21A-B9	—	141	Vetco	Suspended
	UK 16/21A-B10	—	141	Vetco	Suspended
	UK 16/21A-4	—	143	Vetco	Suspended
	UK 16/21A-7Z	—	143	Vetco	Suspended
	UK 16/21A-10Z	—	143	Vetco	Suspended
	UK 16/21A-11	—	141	Vetco	Suspended
	UK 16/21A-14	—	145	Vetco	Suspended
	UK 16/21A-16	—	143	Vetco	Suspended
	UK 16/21B-12	—	140	Vetco	Suspended
TENNECO					
Gulf of Mexico					
Eugene Isle 215	No 5	1976	32	FMC	Abandoned
S Marsh I 61	No 5	1984	41	FMC	Flowing
S Marsh I 67	No 1	1984	40	FMC	Flowing
S Timbalier 169	No 5	1980	32	FMC	Flowing
S Timbalier 196	No 4	1984	43	FMC	Flowing
Ship Shoal 176	No 2	1975	33	FMC	Flowing
Vermilion 246	No 9	1980	41	FMC	Flowing
TEXACO					
Gulf of Mexico					
Caillou I 241	No 1	1962	6	National	Abandoned
North Sea					
Highlander	UK 14/20-12	1985	128	McEvoy	Flowing
	UK 14/20-13	1985	128	McEvoy	Flowing
	UK 14/20-14	1985	128	McEvoy	Flowing
	UK 14/20-15	1985	128	McEvoy	Flowing
Petronella	UK 14/20-16	—	135	McEVOY	Suspended
Tartan	UK 15/16-10	1981	140	Vetco	Flowing
	UK 15/16-11	1981	112	Vetco	Flowing
	UK 15/16-12	1982	140	Vetco	Closed-in
	UK 15/16-13	1982	140	Vetco	Flowing
	UK 15/16-15	1983	140	Vetco	Closed-in
	UK 15/16-16	1983	140	Vetco	Flowing
US West coast					
PRC 2725	CONCEPTION 2	1962	18	Shaffer	Abandoned
	CONCEPTION 3	1962	19	Shaffer	Abandoned
	CONCEPTION 4	1962	24	Shaffer	Abandoned
	CONCEPTION 6	1962	24	Shaffer	Abandoned
	CONCEPTION 7	1962	26	Shaffer	Abandoned
	CONCEPTION 8	1962	27	Shaffer	Abandoned
	CONCEPTION 9	1962	24	Shaffer	Abandoned
	CONCEPTION 10	1962	24	Shaffer	Abandoned
	CONCEPTION 11	1962	26	Shaffer	Abandoned
	CONCEPTION 12	1962	27	Shaffer	Abandoned
	CONCEPTION 13	1962	27	Shaffer	Abandoned
	CONCEPTION 14	1962	27	Shaffer	Abandoned
	CONCEPTION 15	1963	28	Shaffer	Abandoned
	CONCEPTION 16	1963	29	Shaffer	Abandoned
	CONCEPTION 17	1963	34	Shaffer	Abandoned
	CONCEPTION 18	1963	36	Shaffer	Abandoned
	CONCEPTION 19	1964	36	Shaffer	Abandoned
	CONCEPTION 20	1964	38	Shaffer	Abandoned
	CONCEPTION 22	1964	41	Shaffer	Abandoned
	CONCEPTION 24	1966	43	Shaffer	Abandoned
TOTAL					
Indonesia					
Bekapai	G.22	1986	23	FMC	Flowing
UNION					
Gulf of Mexico					
Ship Shoal 269	No 5	1986	60	Vetco	Flowing
Indonesia					
Attaka	ECHO 1	1982	63	FMC	Flowing
	No 11	1982	50	FMC	Flowing
	No 14	1982	48	FMC	Flowing
	No J-1A	1985	64	FMC	Flowing
	No J-3	1985	64	FMC	Flowing
UNION TEXAS					
Spain (Mediterranean)					
Angula C	No 1	1985	117	National	Abandoned

Source: 1986 Subsea Data Services

DRUGS OFFSHORE

Companies stepping up fight against hidden adversary

Jim Redden
News Editor

A mobile rig operating off South America recently was completely shut down for nearly two days after a random search revealed that most of its crew was taking illegal drugs.

This scenario is being repeated often in drilling theaters from the Gulf of Mexico to the African coast. Once considered the *creme de la creme* of hippiedom, the use of illegal drugs is steadily expanding from the back alley to the rotary table, costing the worldwide offshore industry millions of dollars in the process.

While no exact figures for the offshore industry are available, experts say the losses incurred from lost productivity, accidents and thefts have reached mind-boggling proportions. In the U.S. alone, it is estimated the entire industrial community loses $5 billion annually to drug and alcohol abuse on the job.

The problem certainly is not new. However, mid-1980s oilfield economics has shifted attention from the safety manager to the accountant.

"During the boom, everybody had a lot of money and really didn't pay much attention to drug and alcohol abuse," says Wayne Wicks, president of Security Concepts International Inc. of Franklin, La. "Now, everybody has to tighten up and it's (drugs and alcohol abuse) starting to attract a lot of attention. Everyone is looking at the bottom line."

Companies such as Wicks' are flourishing as operators and service companies turn to outside help in their efforts to make their installations drug-free. Internally, companies are establishing strict drug and alcohol programs calling for location searches and the controversial use of urinalysis testing. Additionally, many firms are implementing employee assistance programs to aid drug- and alcohol-dependent employees.

Bob Peterson, president of Laboratory Specialists Inc. of Belle Chasse, Louisiana, says urinalysis tests are proving positive in 28-32% of the workers his company has examined offshore the U.S. and Canada. Peterson is establishing a satellite office in Hong Kong.

Elsewhere, operators deny there is any concern over drug and alcohol abuse aboard their installations. "We have no formal program to combat it (abuse), because we're happy to say we have no problem to combat," said a spokesman for a major UK North Sea operator.

Nevertheless, the scope of the problem was driven home recently in one of the petroleum industry's first seminars devoted to drug and alcohol abuse, held in Lafayette, Louisiana.

Sponsored by Schlumberger Offshore Services on behalf of the Gulf Coast Safety and Training Group, a 13-member panel encompassing most disciplines involved with the problem detailed what the offshore industry is doing to head off on-the-job imbibing.

While relaxed travel to and from locations make land rigs the most vulnerable locations for illicit activity, experts contend the incidents of drug and alcohol consumption are reaching surprising levels offshore.

Heroin in the galley

Security personnel surveyed told of hard drugs and alcohol being found on rig floors and even in crane cabs. They related how urinalysis exams showed helicopter pilots with traces of illegal drugs in their system during flying hours. Another told of witnessing a boat captain taking heroin in the galley of his vessel.

Temporary shutdowns of rigs and platforms are becoming relatively common when searches and urinalysis tests show crew members to be indulging. "That (installation shutdowns) happens quite frequently," confirms Wicks.

Ray Egan, vice president of Drug Education Associates Inc. of Metairie, Louisiana, said agents recently discovered that employees were making amphetamines in the research and development laboratory of one company.

Wicks believes the worst problem area is the service boat. "We recently searched five crewboats and were left with one (drug-free) person," he said. "If you intend to test a crew before they go offshore, you better have another crew ready."

So widespread is the problem that several operators now require that a contractor's crew be certified as drug-free before handed an assignment.

North Sea operators, meanwhile, contend that extremely tight discipline aboard installations there is keeping a close rein on the drug and alcohol situation. Most of those in charge of offshore rigs and platforms in that theater are veterans of the tightly regimented British and Norwegian navies and know all the rig hands under their command. "They know them extremely well as individuals and it would be very difficult to hide a dangerous drug habit," one spokesman said.

Sniffer dogs

In the pioneer days of the North Sea, most of the crews were relatively inexperienced temporary contractors who tended to break the rules. Those types have now all but disappeared in the North Sea and the crews now sign longer contracts and are less apt to go astray. Furthermore, the extensive use of sniffer dogs at transit points make it extremely difficult to smuggle drugs offshore.

Most safety and security personnel agree that the current downturn is prompting many employees to think twice before using drugs or alcohol at work.

"A few years ago, we would catch a guy, fire him and the next day he would go to a competitor for the same or more money," said John Yeager II, security manager for Halliburton Services. "The deterrent value now lies in the fact that if he's fired, he may not get another job."

Why then does the positive rate from drug testing continue to climb? Psychologists point to the inherent remoteness and relative boredom of offshore work, while others contend that many workers just cannot or will not quit their habit.

"After we implemented our drug and alcohol program, I had one guy come in and say he would leave before adhering to our policy and quit using marijuana," Yeager said, noting the employee did resign.

"You have a certain group who simply cannot stop," Wicks noted. Recently, he added, 22 crew members on a single installation were shown to have been using drugs.

To assist those who have a problem with drugs and alcohol, companies are installing employee assistance programs. In most cases, dependent employees are allowed to take time off with some medical benefits to try and kick the habit.

Psychologist recommends diversions for employees

Working two-week tours at a remote location is one of the leading causes of drug and alcohol abuse among offshore workers, reasons a Houston psychologist.

To combat the growing problem, Dr. Jerry Osborne, director of the counseling and testing center at the University of Houston, suggests that operators and contractors develop a program geared more toward prevention than punishment.

"It is my fundamental belief that to combat the problem of drug and alcohol abuse, you must first identify the problem and then provide a better alternative," Osborne says. "Telling people that they simply can't do it very seldom works.

"Boredom can be very debilitating to all of us, and people seek to make themselves feel better. Drugs and alcohol work, and they work very well."

Since there is only so much television an offshore crew can watch, Osborne recommends several alternatives:

- Periodically changing the paint color of crew quarters can prove beneficial, because it offers the crew a continually changing environment.
- Establishing hobby and craft areas that give crew members something to work on during off-hours.
- Where permissible, employees should be allowed to bring easily-maintained pets on board, such as cats, birds and tropical fish.
- The installation and/or mobile rig should include several plants.

As an example of this last suggestion, the platforms on the North Forties field in the North Sea conduct inter-field contests for onboard gardeners, which British Petroleum officials say improves morale and gives employees something to work towards in their free time.

Osborne said books, magazines and weight rooms also should be easily accessible to all workers during their free time. "All of these things give the person another stimulus in which to direct his attention." □

Halliburton offers such a program, but only if the employee voluntarily requests help. If a companywide test reveals an employee is using drugs or alcohol during work, he or she is automatically dismissed.

"If you turn yourself in, you will get rehabilitation," Yeager emphasized. "We believe that if you tell all employees beforehand they will get help if they're caught, they won't quit until they're caught."

A more liberal policy exists at Kerr-McGee Corp. Once a worker is determined to be a user, the offender is sent to a chemical dependency unit where medical experts determine if the usage is recreational or dependency.

If the employee is determined to be dependent, a complete program is prescribed. If the usage was recreational, the employee is placed under 30-day supervision and retested afterwards. If the follow-up test is negative, the employee keeps his job. If positive, termination is the result.

"We firmly believe if an employee has been using drugs, he is not thinking clearly and cannot rationally turn himself in (before being caught)," explained Danny LeBlanc, safety director for Kerr-McGee's Lafayette office.

Mounting insurance claims, coupled with a dismal business climate, are forcing many operators and service companies to stringently enforce their long-standing drug and alcohol policies. The policies have always been there, but only recently has the company hierarchy become directly involved. With the blessing of the executive suite, companies now are taking an extremely aggressive approach toward drugs and alcohol.

Drug-accident linkage

The success of the company programs that have been implemented was reflected by Don Resweber, safety manager of Penrod Drilling Co. Correlating the incidents of lost-time accidents with persons found to be using drugs and alcohol, Penrod found that 80% of accident claims were filed by persons who showed positive in drug tests. Since Penrod implemented its program, insurance claims have dropped 70%, he said.

Before introducing its tougher program in 1983, Halliburton studied two of its U.S. districts and found 30% of its employees were using some form of drugs on the job, Yeager said. Correspondingly, it was learned that

Tight control, communication vital to anti-drug program

The initial step in controlling a drug situation among employees is studying the extent of the problem, its sources, symptoms and causes, advises New Orleans, Louisiana attorney James Carriere.

In studying the problem, he says the company should consider accident and absenteeism records, performance problems and medical records.

Once the scope of the problem has been determined, management should select appropriate control methods, which could include the following:

- Physical searches in common areas of company property, not including employee areas and employee belongings.
- Use of sniffer dogs to search all areas of company property including employee lockers, lunch boxes, etc.
- Physical searches of employees just after they have entered company property.
- Lie detector tests to determine the extent of drug use. This is prohibited in some nations and U.S. states.
- Urine, blood or breathalyzer tests to detect the presence of drugs or alcohol in the system. Urinalysis tests will not detect the presence of alcohol, which must be determined from blood tests.

The latter, by far, is the most controversial testing method and the one contested in most court cases. Following set guidelines, however, nearly always keeps the company clear of legal liability, Carriere says.

"Because positive blood, urinalysis and breath tests can result from legitimate factors (legal prescriptions) and because positive readings can result from activity occurring on the employee's time off, great care must be taken in disciplining an employee based on medical screening tests," he cautions. "Running a second confirmation test is always advisable."

In taking a urine sample, he noted, the person conducting the test should directly observe the sample being taken. The bottle should be carefully marked and a set "chain of custody" established. Each time the chain of custody is broken, it must be noted.

To avoid discrimination actions, Carriere and other experts emphasize that everyone in the particular work area must be tested, regardless of work habits or other considerations.

What occurs afterwards is critical in making certain a company is clear of litigation.

"As in all employee discipline situations, you must be consistent, careful and obtain documentation when disciplining employees for drug-related matters," the attorney says. "In addition, because of the special circumstances presented by drug use or possession, all discipline must be strictly confidential."

All discipline should be done privately and disclosure of test results should be carried out on a "need to know basis." For example, those in the immediate investigation are the only persons who should be advised of the specific charge against an employee. All others should be told the employee was disciplined for "lack of confidence"or a similar vague designation.

Above all, he strongly emphasizes total communication between supervisors and employees. He related a recent case involving a major operator in which an employee was fired because of a positive test result.

"The employee won his suit because he proved that he did not know he could be discharged for not taking the test and was confused over the method of testing," Carriere pointed out.

"Because drug testing and screening is one of the most sensitive areas of employee relations," he added, "and because the potential legal problems are many, you must give long and careful consideration to the implementation of a program." □

50% of accidents involving company automobiles were drug- and alcohol-related. This year drug- and alcohol-related accidents have dropped to zero, he said.

While employees have generally accepted spot searches, opposition has grown over the use of urinalysis examinations. Consistency in enforcing the policies and confidentiality in the results are the catchwords in implementing such a program, legal authorities say.

Legal authorities caution that all employees should be educated on the company's policy and advised that a drug search and/or urinalysis exam will be undertaken. The majority of companies with such policies agree that employees should be given a 30-day notification period.

New Orleans attorney James D. Carriere points out that defamation and discrimination are the basis for most of the successful lawsuits filed in the U.S. by fired employees.

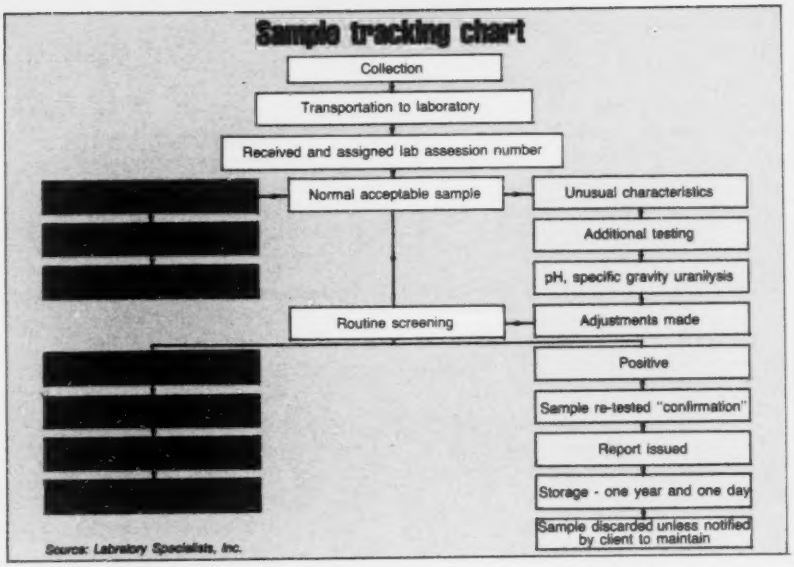
"Federal law does not prohibit employers from implementing drug search and testing procedures for bona fide reasons, and state law restrictions are minimal if certain precautions are observed," he explains. "However, such procedures can have a very negative effect on employee morale, and legal challenges—whether or not they are meritorious—can be bothersome and expensive. Accordingly, you must be very careful in implementing such a program."

The legalities vary from nation to nation and Carriere strongly recommends employing foreign legal counsel when operating in another nation.

For instance, in conducting drug searches and testing on an American-flag mobile rig working in another nation's territorial waters, the U.S. operator, in most cases, will not be allowed to test the nationals working on the rig. If the rig is drilling in international waters, however, all persons aboard can legally be searched by representatives from the nation that registered the rig.

There also is a philosophical restriction to full-scale rig searches in many countries. In a number of nations drugs such as cocaine and opium are frequently used in religious observances and it becomes difficult to admonish some partakers.

"In many nations the use of drugs is a part of their religion, and from an operator's standpoint, it's just something they have to live with," Wicks says. □



Study shows high worker anxiety

Abnormally high levels of anxiety and depression among workers are prime contributors to the accident rate on offshore platforms, according to an extensive study by the University of Manchester Institute of Science and Technology (UMIST) of Manchester, England.

The first-ever study of occupational stress among offshore workers has led Dietsmann International NV of Brussells, Belgium to create a postgraduate studentship in the group's Management Sciences Department for UMIST researcher Valerie Sutherland. Her responsibility is to conduct a comprehensive study of accidents and their relationsip to stress and the working environment on platforms and drilling rigs.

The initial study covered 26 North Sea installations and 37 types of offshore jobs.

One of her preliminary findings revealed that an underlying source of stress among the more than 46,000 workers in the North Sea has been the deterioration of working relationships caused by crew changes, leading to an unfamiliarity with new co-workers on difficult tasks. Ironically, she also noted that long periods of proximity to the same persons also contributed to higher than expected levels of stress.

Other findings noted:

- Compared to their onshore peers, a significant percentage of offshore workers were more obsessional about their tasks and showed more phobic anxiety.
- Offshore workers worried more about their personal safety and fatigue, the competence of their collegues and their ability to keep up with new technigues and equipment.
- The offshore groups studied also exhibited lower job satisifaction levels than their onshore counterparts.

"Between 1980 and 1984 there were 25 deaths and 677 injuries among offshore workers in the British and Dutch sectors of the North Sea," says P.R.G. Kùtemann, president of the Dietsmann Group. "During this time the work force increased by 33% while the number of accidents fortunately reduced considerably as a result of technical safety measures. However, it is acknowledged that 90% of all accidents are caused by human error or negligence."

"It is our conviction that improved offshore safety demands that attention be focused on the employees in their offshore environment," he added. □

War zone transit hazard to vessels

Safety steps advised for Arabian Gulf operations

Avoiding attack or damage while transiting a war zone such as the Arabian Gulf requires planning and timing of movements in the area and preparation of the vessel and crew for quick response should an attack occur.

"Some vessels sailing into the Arabian Gulf have little or no information on the Iraq-Iran war and the serious nature of the activity,"claims Capt. John Harington, marine manager at the Gulf Agency Co. The firm operates crewboats and other vessels for the petroleum industry at Fujairah in the United Arab Emirates.

Harington issues fleet advisories periodically on precautions to be taken during a transit or during attack, including the following:

- Watch for evidence of surveillance by a reconnaisance aircraft (low-flying and circling) or boat, since it usually precedes an attack by 1-3 hours.
- Transit possible attack areas during night hours to defeat observation by reconnaisance craft or the launch of an optically-guided missile.
- After a reconnaissance operation has been observed by lookouts, vessels should alter their course 90°.
- After a missile or torpedo launch is detected, vessels should turn toward or away from the attacker to present a smaller target for radar or sonar guidance, and to limit damage if hit.
- Rig all firefighting equipment and gas inerting systems and maintain high lifeboat preparedness during a transit.
- Reduce radio and radar use and vessel lighting to a minimum to discourage detection.
- Obtain as much local information as possible about attacks . For example, patterns show the most frequent day of attack by Iran or Iraq is Sunday, followed by Friday. Fewest attacks were reported on Thursday or Saturday.

While cargo vessels and tankers present the largest, most vulnerable and valuable targets in the Arabian Gulf, other types of vessels are in danger as well. Harington says attacks were made on 61 vessels of all types by both Iran and Iraq aircraft

during 1984, the highest in the six-year long war. Seventeen of this number were either totally lost or declared total losses.

Reconnaissance patrols

Harington says that Iran uses a four-engine turboprop P-3 Orion for reconnaissance and flies the central sectors of the Arabian Gulf down to the Straits of Hormuz. The patrols fly at 2,000 ft and will drop to 500 ft and circle for target identification and course and speed estimation. All of the attacks on shipping by Iran, Harington claims,"have been preceded by the previous circling of the target vessel."

"If a vessel is circled, the master should wait until the reconnaissance aircraft has continued its patrol and disappeared and then make a 90° alteration of course and head at maximum speed away from the intended course and toward a friendly shore."

Harington points out that Iranian attacks usually occur about 2-4 days after Iraqi attacks on vessels bound in or out of Kharg Island or Bandar Khomeini. Iraqi attacks have centered on the northern side of the Gulf, generally on tankers approaching or leaving Iran's loading terminals.

Attack missiles

Iraqi aircraft usually launch French-built Exocet missiles, which use radar homing systems and can skim the seas at an elevation of 7 ft. The missiles can be launched from a fighter aircraft or helicopter.

After targeting the missile, the aircraft must climb before firing, a procedure that may be visible to the vessel being attacked, although the missile has a maximum range of 25 miles and a speed of 650 mph. At a launch distance of 10 miles, a vessel's master would have one minute to alter course to present a less visible target to the missile's radar.

Iran uses U.S.-built Maverick missiles, which are guided by television. This type of missile must have the target within sight and cannot operate during night hours. For this reason, Harington suggests that vessels transiting international waters in the Arabian Gulf operate during night hours.

Missile launches are accompanied by a visible flash and smoke, Harington warns, and lookouts should maintain a watch on the horizon and 5° above it. Aircraft tend to fly low

"When in mineable waters no one should be allowed below the main deck. . ."

Capt. John Harington

before launching a missile but must climb before firing, at which time they can be seen by a lookout.

Harington suggests the following preventive measures:

- Firefighting equipment should be rigged with fire pumps on line
- Identify equipment which requires immediate damage control
- Identify an area for dealing with casualties and stock it with first aid equipment
- Close all watertight openings and secure heavy equipment
- Move as many of the crew members above the weather deck and issue personal survival equipment to all
- Use inert gas above flammable cargoes or ensure that tanks are made non-flammable. If enerted, a tank filled with oil acts as a sponge when hit by a missile and will not ignite
- Lifeboats should be prepared for immediate launch
- Additional personnel should be provided for lookout routines, including listening to radio traffic
- Show no unnecessary lights during a night transit

Action under attack

Once an attack begins, a vessel has further options to eliminate a direct hit from a missile or keep the damage to a minimum. Harington says that turning a vessel in the direction of the attacking aircraft or boat reduces the chances of impact since the radar echo is much smaller head-on.

"The Exocet missile does not have a large warhead, hence the presentation of the least vulnerable part of the vessel to the attack might limit subsequent damage. The main hazard is likely to come from fire, caused either by the warhead explosion or unburnt solid propellant from the missile motor."

If a torpedo is launched between 30° and 70° on the bow, Harington suggests steering toward the sighting. If the track is more than 70° on the bow, a course away from the sighting should be steered. He adds that the vessel should make 30° alterations in course thereafter to confuse the enemy's fire control.

Harbor attack

Preparations for an attack in a harbor, should one occur, include bringing a vessel to a state of maximum watertight integrity, maintaining manueverability, and preventing any underwater approach to the hull.

Harington says the prevention of an underwater attack includes the placement of lookouts around the vessel. "If possible turn the engines slowly astern, continuously or at short intervals as circumstances permit. Turn the rudder frequently."

In addition, he suggests the dropping of small explosive charges over the side at regular intervals and running a bottom line the length of the vessel to dislodge explosives.

The mining of sea routes and harbors are a frequent problem in a war zone. One of the most important precautions to be taken by vessels in mined areas is to carefully follow routes designated by local authorities or in the path of a vessel directly in front, Harintgon claims.

"When in mineable waters no one should be allowed below the main deck or in a below water compartment except when essential. All watertight doors should be closed."

Harington elaborates on the precautions for various types of mines: When the mines expected are of magnetic origin, the vessel should be equipped with degaussing (anti-magnetic) equipment and tested frequently on a range. If the mines are of the acoustic kind, vessels should proceed at the best noise-to-speed ratio with every effort made to keep propeller vibration to a minimum. Engine reversal should be avoided.

In general, vessels expecting any type of mining should keep to water depths beyond the 180 ft contour, since damages from a detonated mine beyond this depth are minimal.

Harington suggests that companies with vessels operating in the Arabian Gulf take every precaution, even though attacks are few in number.□

Platform removal becomes international issue

Navigation tops concern over removal of non-producing installations.

A number of conflicting interests stand in the way of the development of international standards for the removal and retention of obsolete platforms.

Nevertheless, the worldwide industry faces a multi-billion dollar expenditure as it grapples with the disposal of thousands of installations as offshore fields stop producing.

One of the most widely discussed alternatives for unused platforms is conversion to artifical reefs. The so-called Rigs to Reef measure, however, is being hit by the world's military leaders who decry the proposal as threatening national security.

The International Maritime Organization (IMO), in meetings scheduled to begin next year, is confronting the staggering proposition of formulating standards for the removal and retention of non-producing installations. However, legal complications stand in the way.

"The growing recognition of the legal requirements is long overdue," says Houston consultant Dana Larson. "Also overdue is recognition of the problems and costs associated with platform removal and the opportunities with platform conversion."

"Total removal of OCS petroleum installations is one extreme, while total retention is the other extreme. A position between these two extremes carefully representing the balanced interests of those affected by both retention and removal of selected structures is a logical beginning," adds Larson, who is president of the Rigs to Reef Co., an organization he formed to advocate the conversion of obsolete structures for use as artificial reefs.

Jim Redden
News Editor

Seventeen years after the infamous Santa Barbara blowout on this platform, Corynactis anemones and other encrusting organisms provide a colorful accent for a school of rockfish. (Photo by Steve Carnevale)

More than 6,000 offshore installations are located in producing theaters worldwide, with two-thirds of those sitting in U.S. waters. The estimated cost of removing obsolete structures vary significantly, but have ranged upward to $30 billion.

According to the National Resource Council, which was commissioned by the U.S. Department of the Interior to examine the situation, the costs per structure in the U.S. alone range from $50,000 to more than $100 million. The low range is for units in water depths of 0 to 20 ft, while the high figure is for the ultra-deep structures.

In the U.S. Gulf of Mexico, the NRC estimates by the year 2005, the cumulative cost will reach $2 billion, soaring to $7.5 billion by the year 2020. This figure does not take into account the installations sitting offshore California, Alaska or outside the U.S.

A recent unpublished study, the NRC adds, estimates the associated cost of removing a typical eight-pile Gulf of Mexico structure in more than 300 ft of water would reach $3.9 million with an additional $1.3 million required for offloading, dismantling and disposal.

"The ocean dumping of (Catagory III-V) structures would reduce the total estimated cost to remove all offshore structures through the year 2020 by about $2.5 billion, or one-third," the NRC projected in its recent released report "Disposal of Offshore Platforms."

"The social, economic and environmental cost of removing these structures is immense by any measure, or set of assumptions," Larson said. "Likewise, the lost opportunities associated with pre-abandonment are also immense."

Basic regulations

Much of the discussion surrounding the international question centers on Article 5.3 of the 1958 Geneva Convention on the Continental Shelf, a treaty which the U.S. Senate ratified. The clause states: "Any installations which are abandoned or disused must be entirely removed."

"The potential significance of this absolute requirement grows daily as existing OCS structures continue to grow older, as the price of energy remains low and as the economic health of offshore operators continue to deteriorate," Larson said.

Evaluation of platform removal has already begun on the international level. The so-called OSLO Commission last January introduced the subject to the Maritime Safety Committee of the IMO. The commission authorized its Safety of Navigation subcommittee to investigate the subject beginning with its 33rd meeting in January. The basis for this investigation is Article 60 of the Law of the Sea Treaty.

While then-U.S. President Richard Nixon initiated the Law of the Sea concept in the early 1970s, the U.S. was not only not a party to the treaty, but campaigned vigorously against its ratification. The treaty presently lacks sufficient support to be declared international law.

The primary difference between Article 5 of the 1958 convention and Article 60 of the Law of the Sea treaty is the more flexible language in the latter. Article 60.3 of the LOS states, in part: "Any installations or structures which are abandoned or disused shall be removed to assure safety of navigation, taking into account any generally accepted international standards in this regard by the competent international organization. Such removal also shall have due regard to fishing, protection of the marine environment, rights and duties of other states. Appropriate publicity shall be given to the depth, position, dimensions of any installations or structures not entirely removed."

Current legal status

Last May the U.S. Department of State convened in preparation of the IMO meetings the Interagency Group on Oceans' Policy and Law of the Sea. The interagency group also included the Department of Defense, Department of the Interior, Department of Commerce and the Department of Transportation.

"These are the same entities that have been struggling for three years to agree on the language of the memorandum of understanding that would allow selected OCS structures to remain in-situ in U.S. waters," Larson says.

In interpreting the language of the LOS treaty, the interagency group agreed it requires the removal of structures when they are no longer used for their primary purpose. There can be exceptions, however, and the group now is concerned with when exceptions can apply, criteria for allowing exceptions on a case-by-case basis and the appropriate navigational safety standards that may apply.

"The argument is now being made among certain quarters that selected energy installations should be left on the OCS for other uses. A shorthand version of this concept has been called rigs to reefs," Larson said.

Diverse priorities between the different nations represented at the IMO as well as the various U.S. agencies stand in the way of the establishment of concrete international standards. The most startling distinction between the countries represented at IMO may be the party ultimately responsible for removal. The Norwegian government, for instance, is responsible for 90% of removal costs on that nation's outer continental shelf, while the U.S. subsidization for platform removal is limited to 38%.

While each nation and governmental entity has its own vested concern, the question of navigation appears to be of universal interest.

The concept of toppling obsolete platforms and converting them to artificial reefs has been hit strongly by

Rigs-to-Reef advocates say platforms

Offshore production platforms should provide both energy and protein to the world's residents, say proponents of the so-called rigs to reef measure.

"Platforms increasingly are being recognized as de-facto reefs of superior quality. Total removal of platforms will aggravate fishery problems by decreasing habitat and thereby increasing the potential for overexploitation and the competition between the sport and commercial fisherman," says Dana Larson of Houston, founder of the Rigs to Reef Co., a consulting firm dedicated to converting obsolete structures into artificial reefs.

The success of fishing, Larson adds, is directly related to the quality and extent of the marine habitat. He says petroleum platforms, whether producing or obsolete, provide excellent fish habitat.

Larson eludes to earlier studies conducted in the Santa Barbara Channel off California, which revealed that 20,000 to 30,000 fish representing more than 45 species could be found on or around the platforms. Furthermore, the Gulf of Mexico Fishery Management Council says oil and gas structures account for 28% of hard bottom habitat with new species being detected everyday. A number of new species found in the Gulf previously lacked an adequate natural habitat and their presence may be attributed to platforms.

"Prior to the installation of the platforms, these newest species had no suitable habitat in which to expand their range," Larson notes. "Few, if any, natural ecosystems surpass those of OCS structures for biologic productivity."

Taking note of the value of obsolete platforms in fostering marine life, the U.S. Department of State is considering the establishment of mariculture projects in major oil producing theaters, including Southeast Asia, the North Sea, West Africa and the Middle East.

the U.S. Department of Defense. Secretary of Defense Caspar Weinberger has gone so far as to say sunken platforms could prove harmful to national security.

In a 1984 letter to Charles DiBona, president of the American Petroleum Institute, Weinberger expressed more concern over submarine navigation than surface navigation and noted obsolete platforms could provide hiding places for hostile submarines.

"From a global perspective, the proliferation of non-producing offshore structures could seriously degrade the mobility and flexibility of our seaborne forces," he wrote. "Therefore, we agree fully that international standards are required."

He went on to say that effective removal standards "must be binding and coastal state discretion must be minimized. Without these elements, coastal states could come to their own conclusions as to what is reasonable, which could defeat the very purpose of uniformity that international standards are meant to serve. Only globably established standards, which carefully deiimit minimum and maximum depths for removal, can protect against abuse by other countries."

The Department of Defense's minimum standards call for the removal of offshore structures "within five meters above the sea floor in waters less than 400 meters, to within 15 meters above the sea floor in waters less than 2,000 meters and greater than 400 meters."

Attempts to explain that producing structures offer the same nevigational hazards and hiding places as non-producing structures have been unsuccessful. The argument has been further made that the well-planned concentration of obsolete structures may actually be less of a hazard. The advocates for the rigs to reef measure continue to point out that most artificial reefs used for recreational fishing purposes would be in waters normally too shallow for the safe navigation of nuclear submarines.

Alternate methods

Sensing a growing need for specific answers on platform removal, the Department of Interior two years ago authorized the NRC to evaluate alternative dispositions for platforms. The NRC recently issued four recommendations, which include:

- The Department of Interior should amend its removal policy to allow determination of the ultimate disposition of offshore platforms on a case-by-case basis, in accordance with predetermined standards and criteria. These standards and criteria should be consistent with international law and preferably the product of explicit international agreements.
- The U.S. should develop a national position on the disposition of offshore platforms for submission to the International Maritime Organization for international consideration. The U.S. Coast Guard should initiate this process promptly, in concert with the Department of State, Department of the Interior, Department of Defense, Environmental Protection Agency and other interested agencies and non-government interests.
- The EPA should establish a limited number of dump sites for the disposal of offshore platforms and a policy and permitting procedure regarding use of these dump sites. In addition, the EPA should consider establishing a general permit, similar to that for the disposal of ships, for the disposal at an ocean dump site of the few largest offshore platforms.

The Marine Protection Research and Sanctuary Act currently prohibits the dumping of platforms and considers ocean dumping the last resort for disposal of material.

- The Department of the Interior should develop a proposal designed to provide relief from liability to former owners of platforms where the means of disposition approved by the government does not do so.

Industry fears of lingering liability is the most serious impediment to platform donations for artificial reefs and other use purposes, Larson says.

The NRC suggests an industry-based trust fund or insurance scheme. The agency further says government assistance, possibly funded from savings accrued through the di-

should provide protein as well as energy

In its purest form, rigs to reef is a concept where the owners of the "environmentally best offshore structures" are requested to voluntarily participate on a case-by-case basis to enhance the fisheries best suited for that location, Larson explains.

Several companies have intentionally placed platforms in U.S. waters over the past 10 years. By far, the most celebrated incident occurred last year when Tenneco Inc. sank all or portions of three unused Louisiana platforms in Florida waters.

"The reef is one of the finest in the Atlantic and is readily available to one of the world's largest fishing and boating communities," Larson says.

A number of companies, individuals and associations support a voluntary and planned rigs to reef program. Among those actively supporting such a measure are the National Ocean Industries Association, the Sport Fishing Institute, and Louisiana, whose Louisiana State University Center for Wetlands Studies, helped create the Louisiana Artificial Reef Inititive (LARI).

The LSU wetlands study center recently estimated that 179,512 licensed saltwater recreational fishermen annually spend $180 million in the state with the total contribution to Louisiana coffers conservatively estimated at more than $640 million.

"It's clear that a primary benefactor to this (LARI) will be the recreational fisherman," says Dr. Charles Wilson, LARI chairman. "Unlike petroleum, fisheries can be a renewable resource."

Creating artificial reefs is certainly not new. The Japanese centuries ago recognized the value of artificial reefs when their catches around sunken vessels improved dramatically. The Japanese are presently investing the equivalent of $60 million yearly to install artificial reefs that, according to Larson, have a startingly similar appearance to OCS petroleum structures. □

minishment of income tax expense deductions by industry for platform removal, could help fund this proposal in the future.

Liability implications

On another scale, the National Artificial Reef Plan attempted to relieve prior owners of liability and to relieve current owners of artificial reef permits immunity so long as pertinent or relevant permit requirements were being met.

A U.S. program on converting platforms and other OCS installations into artificial reefs, however, requires cooperation between the Department of Interior and the Department of Commerce.

"The Department of Interior has jurisdiction over structures, but has little fishery expertise," Larson explains. "Commerce has fishery experience, but only minimal involvement with platforms. The artificial reef movement would be enhanced by greater cooperation between these two agencies."

Meanwhile, the London-based International Exploration and Production Forum (E&P Forum) is actively promoting its position to the IMO.

It has been estimated that one-third of the world's offshore structures are located outside U.S. waters. Correspondingly, removal costs have been said to be twice that of U.S. installations.

The forum's basic request is for the complete removal of structures in less than 40 meters of water upon their abandonment or disuse. In water deeper than 40 meters, navigational obstructions are to be cleared to a depth of 40 meters and the position and size of remaining installations clearly marked on nautical charts. The larger platforms, according to the forum, should be merely toppled in place.

Artificial reefs are an acceptable exception to removal.

Navigational considerations

Navigation continues to be the primary hinderence to any concrete set of standards. There also appears to be grave inconsistencies in the wording of the Geneva Convention pretaining to navigation.

Article 5.1 of the Geneva Convention allows petroleum exploration on the continental shelf providing these activities "do not result in any unjustifiable interference with navigation,

Platform removal subject of conference

The political and economic ramifications of removing abandoned platforms will be addressed in the first Offshore Decommissioning Conference scheduled later this month in London.

"With more than 90 permanent offshore oil and gas structures and some 2,600 miles of pipeline in the U.K. sector of the North Sea, the problem of decommissioning will be monumental," a spokesman said.

The conference primarily will be a forum for discussion between operators, contractors, government departments, academic and other relevant bodies, according to Offshore Conferences and Exhibitions of London, organizer of the conference.

The conference will be held Nov. 25-26 at the Heathrow Penta Hotel, Heathrow, London. Further information is available from Offshore Conferences and Exhibitions Ltd., Rowe House, 55/59 Fife Road, Kingston upon Thames, Surrey. KT1 ITA. UK. Telephone: 01-549 5831. Telex: 928042 SPEARS G. □

Costs of removing Gulf of Mexico platforms

Time of Removal	Water Depth Category 0-20'	20'-100'	100'-200'	200'-400'	400+'	Total	Cost (millions)
1985	27	5				32	9
1986	35	5				40	11
1987	26	21				47	24
1988	34	22				56	26
1989	48	18				66	25
1990	68	24				92	34
1991	92	34	1			127	49
1992	85	41	5			131	63
1993	68	36	2			106	49
1994	86	50	12			148	83
1995	74	60	9			143	84
1996	75	57	4			136	73
1997	77	62	5			144	80
1998	61	40	18	5		124	129
1999	54	26	19	11		110	177
2000	59	30	26	8		123	163
2001	56	46	25	3		130	125
2002	59	36	29	18		142	273
2003	59	29	23	9		120	167
2004	37	15	12	9		73	131
2005	63	24	18	23		128	295
2006	60	30	18	28		136	350
2007	44	46	20	17	1	128	294
2008	65	53	36	29	3	186	532
2009	103	47	28	20	1	199	351
2010	89	56	35	19	2	201	398
2011	79	68	37	12	2	198	340
2012	101	63	28	1	2	209	355
2013	132	67	14	8	2	223	271
2014	105	53	16	5	2	181	226
2015	105	53	14	7	1	180	203
2016	105	63	19	10	2	199	290
2017	105	65	25	13	4	212	412
2018	105	65	30	14	4	218	431
2019	105	65	30	20	4	224	491
2020	105	65	30	20	4	224	491
Totals	**2,746**	**1,786**	**588**	**328**	**34**	**5,482**	**$7,505**
Previously removed	**95**	**246**		**5**		**346**	

Source: National Research Council

fishing, or conservation of living resources of the sea, nor result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication."

Larson suggests the wording "unjustifiable interference" offers some leeway in the removal of obsolete structures.

However, Article 5.5 requires complete removal of abandoned or disused installations. This would indicate no leeway.

"Spokesmen for the oil and gas industry have frequently stated that offshore structures are navigational aids," Larson says. "Furthermore, platforms have many times provided safe haven to mariners."

"It will be interesting to see how, if at all, the differences between the Navy and the E&P Forum are reconciled. Both are driven by their own interests," Larson added.

Members of the Exploration and Production Forum would rather all but the estimated 373 existing structures in very deep water be removed in order to protect tankers. The remaining installations, the forum contends, could be eliminated through partial toppling.

The navy, on the other hand, would prefer no hinderence by any structure, either above the surface or subsurface.

"Ironically, the navy has been one of the most active of the larger artificial reef participants in the U.S. with its disposal of installations off Panama City, Florida and vessels at Argus Island off North Carolina," Larson contends. "In the past, the navy has obtained artificial reef permits for unwanted vessels and have used them for target practice."

Until exhaustive studies are completed and standards issued, Larson fears companies could face lawsuits if they continue to remove obsolete platforms. He adds: "It seems reasonable to conclude that answers to how, or if, platforms will be removed will occur, but will come only after considerable study."

The long-awaited development of standards now rests squarely on the shoulders of the IMO, which must confront a number of conflicting interests.

"There is no doubt that the IMO is the competent international organization capable of developing international navigation standards. Depending on vested interests, there may be some concern that navigation is the paramount issue surrounding platform removal. Likewise, there may be some concern over whether the IMO is the proper body to discuss such issues as fisheries, economics, protection of the marine environment and other rights and duties of nations," Larson says. □

Crisis overload: too much data, too little time

Need for expert systems developing on large platforms

Leonard A. LeBlanc
Engineering Editor

An offshore platform with multi-well production and process facilities can generate as much as 20,000 items of information from sensors. During a crisis, this volume of information can overwhelm a human operator's ability to solve problems or avert disaster.

Two successive generations of automation, (1) supervisory control and data acquisition (SCADA) systems introduced in the mid-1970s, and (2) distributed process control (DCS) systems developed in the early 1980s, have provided platform operators with a huge quantity of data to monitor many complex processes in real time. While the information is vital, the operating crew's ability to comprehend and interpret is limited by the speed of human capacities.

To the rescue comes expert systems or artificial intelligence, which "provides less, but more intelligent, information," as one specialist says. When a parameter or measurement is exceeded, an expert system will query the stream of data, evaluate the likely problems, and provide a prioritized set of solutions, all in a much shorter span of time than any group of humans could attain.

Unfortunately, developing such a system has proven very difficult. Onshore, low level expert systems have been linked to computers at several chemical plants in the United States. Offshore, basic artificial intelligence software has been developed for well control and drilling. Creating a much more complex set of rules and reasoning intelligence for platform production and processing is slow in coming.

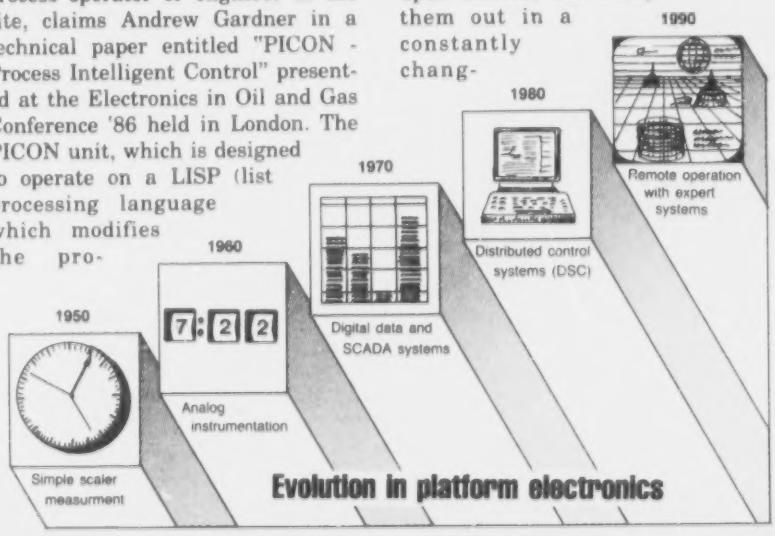
In addition to the overall complexity of platform production management, the current trend in the merging of SCADA, which is centralized monitoring and control, and DCS, where the data is processed in local areas of the platform, is creating an even greater need for automation of problem analysis functions. One expert system, PICON (process intelligent control), is emerging as a possible candidate for offshore application. Another system, ESCORT (expert system for complex operations in real time) was a demonstration device for North Sea applications, but may actually be deployed in time.

PICON is the first expert system designed to be programmed by the process operator or engineer at the site, claims Andrew Gardner in a technical paper entitled "PICON - Process Intelligent Control" presented at the Electronics in Oil and Gas Conference '86 held in London. The PICON unit, which is designed to operate on a LISP (list processing language which modifies the program as the list is executed) system, is currently being used in three U.S. chemical plants and eight defense industries. The chemical plant installations were made in 1985, after a two-year development period.

The PICON unit, Gardner says, interfaces with a distributed control system (DCS), which in turn monitors as many as 20,000 measurement points. The unit "requests data as required for inference, but does not force the distributed system to transmit all measurements and alarms on a fixed scan basis."

The PICON system extracts data from a range of incompatible communications systems, queries the distributed control system without imposing too great a load on it, and must also deal with the higher bandwidth of the SCADA system, Gardner says.

The mainstay of the expert system is the "real time inference engine." Gardner says the inference (logic) engine has been designed to gather data, arrive at conclusions, decide upon actions, and carry them out in a constantly chang-



Evolution in platform electronics

ing environment. "It must be capable of changing its plans when circumstances change, and be able to operate as best it can with incomplete data."

"The system provides backward chaining (cause and effect) because a variable may request the values of other variables that it needs in order to determine its own status," Gardner says. Forward chaining occurs because variables also have the ability to excite other variables when they enter a certain state as specified by lists.

PICON mimics the plant operator, who upon detecting a deviation, looks at additional variables to identify the cause of a deviation. "Primary rules are working all the time at their individually specificed scan rate. If these rules are triggered, they can bring up further sets of rules to check, for example, if an imbalance in a volume flow calculation is due to sensor failure or leakage."

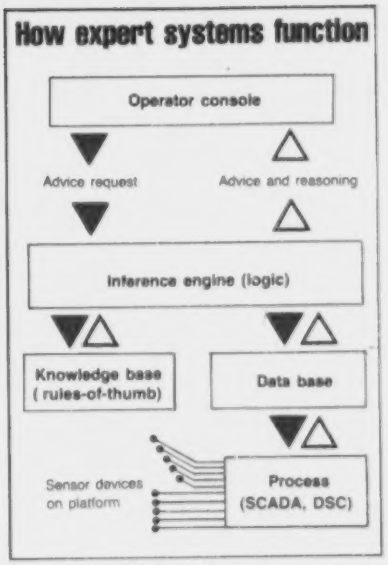
Expert systems learn

In late 1984, a demonstration artificial intelligence project, known as ESCORT, was set up by a UK company, PA Computers and Telecommunications (PActel). The company uses knowledge engineering to formulate operator handbooks for offshore platform control rooms and sought to improve an operator's response time in emergencies. The project provided a simulation of part of an existing North Sea production platform on a conventional real-time computer system.

ESCORT researchers found the transfer of knowledge from the experts to the electronic expert system the most difficult element in the development of expert systems. "Inevitably, the question/answer methodologies become repetitive, complex and seem to challenge the credibility of the individual expert providing the knowledge."

While proving the knowledge engineering concept, PActel developed several significant conclusions in the development of expert systems. They were presented by Alan Jardine of PActel in a technical paper entitled "Managing Expert System Projects for Operational Environments" at the Electronics in Oil & Gas '86 show:

- Expert system projects should be applications led
- Programming teams should be small, with balanced disciplines and team-oriented personnel. Knowledge engineering is an intimate process.
- Innovation can be managed with competitive spirit
- Methodology maturing becomes very important.



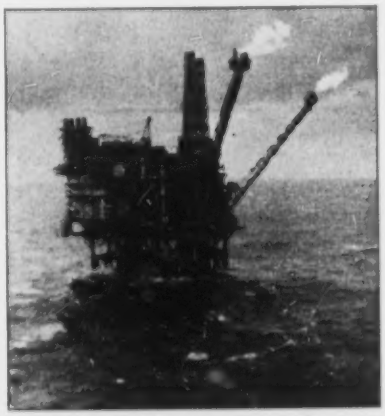
Data for the knowledge base must be categorized for proper rule-making and inferencing to take place. Jardine says data for the ESCORT system was set up in four categories:

Process—Includes physical properties necessary to design the process (fluid densities, vapor pressures, steel characteristics) and mechanical information about the process components (capacities, geometries). Requires specifications from manufacturers literature and process designers' library.

Instrumentation, Control—Detailed knowledge about all of the instruments and control loops must be extracted from design diagrams. Computer-aided design will eventually provide a faster method of information gathering.

Management policies—Easiest to acquire, but more difficult if the operation is still under development.

Operating strategy—This would include such aspects as maximizing oil flow or extraction from reservoir, flaring policies, and meeting contract quotas. Jardine claims this would be the most confidential information.



A modern platform has many processes going on simultaneously, all of which can overwhelm decision-making in an emergency. Computerized expert systems are being examined to assist operators on such occasions.

Jardine said the ESCORT system, which is built on an artificial intelligence work station linked to the data bus of the process simulator, can be switched on during problem scenarios to provide advice. A touch-sensitive video screen provides fast interaction and exchange of information. Rules and knowledge can be added or modified at the engineer's terminal.

Upon activation and evaluation of the problem, the screen displays the result in three sections: (1) an advisory, (2) the likely result of the problem in process terms, and (3) all of the alarms that were set off as a result of the problem. If the operator asks for an explanation of the displayed advisory, the screen will provide the reasoning leading to that advice.

At this point, Jardine says, the operator can choose to follow or ignore the advisory. "He may detect a flaw in the inferencing process. Such an observation would provide basic information for an engineer to extend or mature the knowledge base of the system."

In order to provide timely advice for operating personnel, Jardine said the expert system must provide a one-second response time. The time interval is compatible with SCADA and DCS systems. This could be difficult to maintain when as many as 20,000 items must be scanned.

Jardine said the demonstration has proven the power and possibilities of expert systems for offshore platforms. While these systems have not been deployed offshore as of yet, the need is great. □

Microwave technology invades oil industry

Waves liquefy cargoes to improve well flows downhole

Hydrocarbon emulsions are poor conductors of heat. In bulk quantities, long term applications of heat with precise controls are required to prevent extreme temperature differences, oxidation or combustion.

While plants and specially-equipped locations have steam traces and electrical heat exchangers to maintain the necessary temperatures for emulsion, viscosity and pumping, dockside, over water, and remote sites are not equipped for such handling.

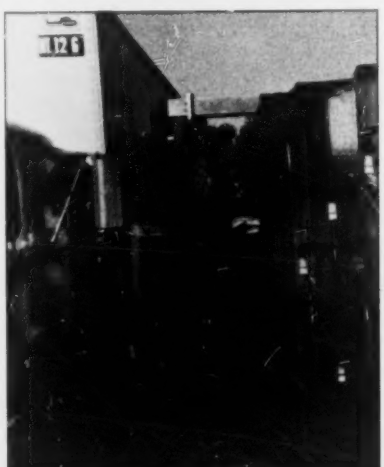
Microwave heating, a mainstay in medical and cooking applications, is being used increasingly in two major areas of the petroleum industry as the hardware is perfected.

- Bulk quantities of oil-based emulsions or drilling fluids with heavy components are fluidized for better flow characteristics, handling, or separation of components.
- Heavy reserves and paraffins are being heated downhole to boost recovery from stripper wells, tar sands, and areas where steam cannot be used.

Microwave technology has been used to spot heat cargoes of oil-based emulsions. The barge industry is now exploring the use of shaft-powered microwave units to maintain the fluency of viscous liquid cargoes such as asphalt, crude oil, bunker C and some chemicals.

Microwaves, which are radio frequency waves (300 megahertz to 300 gigahertz) in the electromagnetic spectrum, subject molecules to a high frequency magnetic field. As the polar molecules align themselves with the alternating polarity of the field, the internal friction caused by the alignment causes heat to be generated. The rate of heating varies with the viscosity. Heat is generated faster in more viscous solutions.

A method of using microwave generation to emulsify and separate viscous oil-based fluids was developed and patented by William Klaila, president of Electromagnetic Energy Corporation of Lafayette, Louisiana. The company has also developed a transportable microwave generator for dockside or over-water use.



An oil tank is treated with microwave energy to separate out heavy components and improve flow. The system's wave guide stretches to the tank from the power source in the truck.

The system developed by the company consists of a microwave generator, a conduit or wave guide to direct the energy to the emulsion, and a directional deflector, which broadcasts the energy into the emulsion through a radio-transparant applicator. The energy can be directed to a specific area of the emulsion or in all directions. The generator has a power production of 30-60 kW at about 915 MHz.

Klaila claims the technology is being used to peform a variety of functions in the industry:

- Unwanted materials such as water, metals, bacteria and sediments can be removed or neutralized in hydrocarbon fluids.
- Hydrocarbons can be removed from drilling fluids and sands.
- Sludges and residuals can be removed from tanks, barges, vessels, pipelines, production tubing and process piping.
- Both hard and soft paraffins can be reduced to a liquid form and returned to emulsion.

The process is also finding applications in enhanced oil recovery, particularly in cases where formations are shallow and cannot be steam flooded. In addition to Electromagnetic Energy Corp., Uentech Corp. of Tulsa, Oklahoma has developed a commercial means of applying microwave energy to formations for enhanced recovery purposes.

The energy can be used to open well casing slots and perforations in production tubing where a buildup of paraffins has plugged up the ports. Microwaves will also improve the flow velocity of both light and heavy hydrocarbons. Microwave energy can be directed in a 360° circumference in the pay zone without wasting energy.

Electromagnetic Energy Corp. uses chemicals in association with microwave heating to boost production in older plugged wells where steam is not effective. In such cases the fines or small particles eroded from the formation have packed around the well bore, aided by oil wetting. When steam is injected and the well allowed to flow, the hydrating water causes an oil mastic to form after production begins. To counteract this, Electromagnetic Energy Corp. uses a chemical system along with microwaves.

The company has also proposed to use microwave energy with chemicals to extract oil from tar sands and to produce oil and gas from oil shale.

Uentech has perfected the radio frequency heating hardware design and a well completion method to boost production from stipper wells. The system, according to its designers restricts the heat to the pay zone and maintains the necessary temperature at the correct depth.

In principle, the Uentech microwave system works similarly to the unit developed by Electromagnetics Energy Corp., except that the wave guide is much longer. Uentech has developed a electromagnetic exciter to heat reservoirs near the borehole.

The advantages of microwave heating in the borehole are continuity of the process, operation in relatively impermeable formations, insensitivity to depths and the fact that no fluids have to be injected. □

Expert system analysis probes diesel problems

Computer now trouble-shoot, predict maintenance requirements

Decision-making influences the operational effectiveness of vessel power plants in day-to-day situations, and especially in emergencies. Most machinery spaces operate untended and chief engineers control engines from the bridge, making the problem even more difficult.

The rapid development of four-stroke medium-speed diesel engines alone requires a knowledge of the various models, makes and tuning necessary for those decisions.

"The most valuable expertise is that in the minds of engineers and technical managers," claims Ingmar Ahlqvist, diesel section manager for Wartsila. Ahlqvist presented a paper on the development of an expert system for trouble-shooting diesel performance and problems at the Eighth International Marine Propulsion Conference earlier this year.

One of the problems with the sharing of an expert's expertise through training programs, Ahlqvist says, is that the number of experts will always be limited. Hence, the development of Wartsila's fault indicating knowledge system (FIKS).

The development of the FIKS expert system involved two stages, Ahlqvist says. The first is the development of the basic computer program which links the input-user to the knowledge base via the interface system. The programs are written in a language that handles symbols, experience and rules of thumb. Loading the shell with knowledge is the second stage.

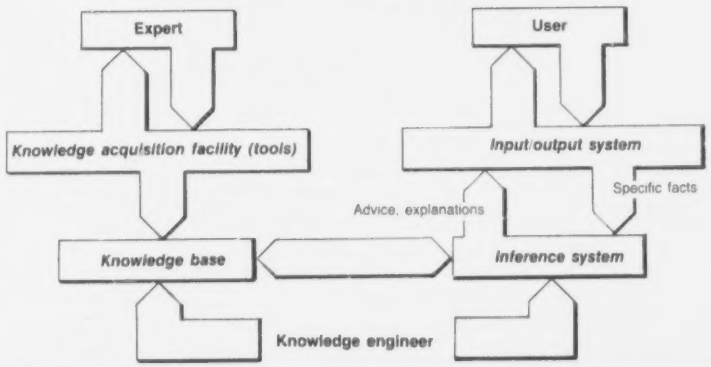
"The challenge lies in the interviews with human experts who pass on their knowledge to the system," Ahlqvist says. "Experience of discussions and technical meetings is an obvious advantage, though the motivation and communication skills of the interviewer should not be understated."

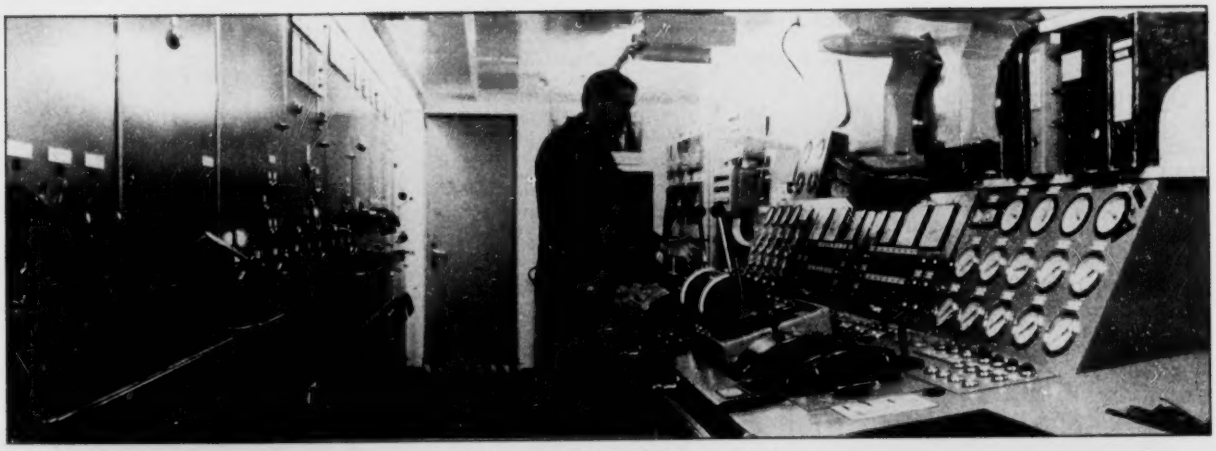
Instead of using symbolic machines tailor-made for the specific task of knowledge engineering, Ahlqvist says Wartila's FIKS system is designed for use on an IBM PC MS-DOS machine, the most common installation on offshore vessels.

"The system asks for opinions and observations rather than specific values. To evaluate their 'weight', the observer's opinion of each probability should also be given, and in such cases, questions are asked via the screen," Ahlqvist explains.

"The chief engineer will be able to ask the system how it came to its conclusions. It is also possible to get a complete reasoning report which gives all the facts and rules involved."

Structure of an expert system





A vessel's diesel machinery operates with a minimum of attention and expert system analysis becomes important to the operational effectiveness of the engines, especially in emergencies.

The inquiry screen shown above helps develop probabilities by making inquiries of a human expert. The arrow on the scale is then moved appropriately.

Expert system software allows a user to check on how a result was achieved, shown above, or go directly to a recommendation for action.

Ahlqvist says the highest possible standard of input accuracy is needed to get the best use of the system, which means it was necessary to develop support systems.

In order to produce satisfactory conclusions the expert system needs input information on the condition of at least some components, Ahlqvist maintains, so a condition measuring system was developed.

"There is no such physical property as condition, so the state of the engine must be judged indirectly. After testing many different methods of indirect measurement, the technical staff of Wartsila concluded the best and most reliable method was temperature measurement utilizing thermocouples."

Watsila's system is called EnCoM, for engine condition monitoring. It includes four groups of engine processes and components.

"Load balance monitoring is done by thermocouples in holes drilled in the cylinder head. The temperature indication is not affected by the exhaust gases from other cylinders because the thermocouples are so close to the combustion chamber.

"A comparison of the temperatures of the individual cylinders and a calculated mean value give the load balance condition of the engine, while a comprehehsive display of the readings appear on a monitor screen.

"The condition of the exhaust valves is monitored by the same sensors as those used for load balance monitoring. A very interesting connection between the condition and the temperature is used here. A burned spot on the valve disc will, as time goes on, result in greater fluctuations in the temperature because the valves are rotating. A malfunctioning valve can be detected by comparing the fluctuation with an alarm level giving the permissible value.

"The cylinder liner temperature reveals not only malfunctions of the liner but also those of the piston and the piston rings. The main bearing is monitored by thermocouples in direct contact with the bearing shells. In medium-speed engines this system reacts quickly enough to detect critical changes in the bearing conditions."

Other than engine systems, there are few other parameters important in rendering decisions on engine functions. Ahlqvist says the availability of spares will affect the decision to stop the engine in an emergency situation.

"Non-real-time information from previous similar situations would likewise add to the probability of a correct decision. However, to be useful, this kind of information must have a very short access time, and therefore must be stored in a computer memory."

In order to deal with this problem, Ahlqvist says Wartsila developed a machinery management (MaMa) system, which is pre-loaded. The program is given the initial engine-specific values before use, which are keyed in from the instruction book and spare parts catalog issued by the engine manufacturer.

"This is a very tedious task. If the engine manufacturer has developed the system and has computers to do so, it can easily include these starting values in the program."

Installation specific

In order to facilitate the use of the Wartsila's pre-loaded management system, Ahlqvist says, many of the functions are adapted to the installation concerned.

"The headings given in the menu system contain data specific to the installation, such as the name of the ship, the type of machinery and the number of engines," he says. The menu is used to help people who feel awkward in front of a computer screen and keyboard.

"Artificial intelligence and expert systems form an interesting and expanding area. However, for the marine industry, neither of these two properties make the purchase of a system justifiable. The persuading factor must be the improved profitability achieved for the operator." □

Understanding new EPA mud rules

Gulf of Mexico regs changing industry operations

Maurice (Mo) Jones, V.P.
ENSECO Houston

The new discharge permits issued this summer by the U.S. Environmental Protection Agency (EPA) for oil and gas operations in the Gulf of Mexico are proving to be very controversial.

Issued jointly by EPA Region IV of Atlanta and Region VI of Dallas, the permits were effective on July 2, five days after being signed. Operators discharging under the previously issued permits had up to 45 days to notify EPA whether they intended to be covered by the general permit or seek an individual permit by the Oct. 7 deadline.

The permits were issued under the National Pollution Discharge Elimination System (NPDES) in the Clean Water Act (CWA).

They were designed to reflect EPA concerns that the biologically productive Gulf of Mexico is being harmed by discharges from exploration, development and production activities.

Within minutes after issuance of the permits, two conservation groups, the Sierra Club and the National Resources Defense League, filed suit against the agency, charging the permits were too lenient. A few days later, Conoco filed a suit against the EPA because it believes the permits to be too restrictive and would "irreparably" harm the oil industry. Additional legal action also is being considered at this writing.

The purpose of this article is to attempt to simplify the complexity of the permit language and to explain the new terminology which is confusing many Gulf Coast operators and service companies.

Many details will not be discussed and each permitee should first read the permit carefully. Each permitee must decide his own policy and practices to be used in complying with the permit.

No warranties are made for any recommendations made in this discussion. The purpose of this article is to assist the permitee in understanding and complying with the permit and should not be considered as legal advice.

Background

The controversy basically arose because the permits represent more stringent requirements for permitees than any other permit issued in the Outer Continental Shelf (OCS). The only exceptions may be highly regulated regions, such as the Alaskan OCS.

The congressionally-written Clean Water Act requires the EPA to strengthen the permits to meet certain deadlines established by Congress. The previous permits were written under BPT (Best Practicable Technology) and BCT (Best Conventional Technology). Congress now wants new permits issued under BAT (Best Available Technology, Economically Achievable), which is a more stringent requirement. The additions of the new requirements under BAT are creating the controversy.

When the original draft permit was issued on July 26, 1985, it contained different and less restrictive requirements than the final form that evolved a year later. The industry was largely unprepared for the sudden shift by the EPA.

Four hearings were held last year and a workshop in New Orleans on July 23, 1986. The hearings and workshop helped to clarify certain issues, but a great deal is still left open to personal interpretation. The industry was seeking a judicial or administrative stay, and assuming it is not granted, the new permits will be the law for the next five years. The permits could be changed, depending on the outcome of any litigation, but would be in effect during litigation.

When the New Source Performance Standards (NSPS) for the offshore oil and gas industry are finalized in 1987, additional changes may also occur, particularly for new platforms.

In order to allow the reader to compare the permit to the discussions in this article, the article is arranged according to discharge streams as listed in the permit.

Drilling fluids

The permits regulate the discharge of drilling fluids very closely.

First, no "free oil", as determined by the traditional receiving water "sheen" standard, is allowed for drilling mud. Discharging is legal only during times when a visual sheen can be seen, providing it occurred from the discharge. This will preclude discharging at night unless the surface of the ocean can be illuminated, or an alternative test method is approved by the EPA.

This requirement, in essence, is meant to prohibit the use of diesel oil as a lubricant or to prohibit mixing waste oils into the drilling mud. Additionally, the discharge of oil-based drilling fluids is prohibited.

The only exception to the diesel prohibitions is in freeing stuck pipe by the addition of a diesel pill to the mud. If a diesel pill was used, the mud can still be discharged assuming the pill and at least 50 bbl of mud on either side of the pill are removed for onshore disposal.

Another requirement is for the operators to participate in the EPA/API Diesel Pill Monitoring Program (DPMP). The DPMP requires that operators take a sample of the mud before spotting the diesel pill, a sample afterwards, plus a diesel sample. The samples are then required to be sent to the EPA/API laboratories for chemical and bioassay analysis. The program is to be in effect for one year

Complying with EPA rules expensive proposition

Compliance with the new drilling fluid discharge rules will increase operating costs significantly.

Bioassay tests typically cost between $650 to $1,000 for each test. Furthermore, sheen and retort tests, when run by an independent lab, typically cost $50 to $100 each.

Additional expenses, including sample containers, transportation, etc. must also be factored. For a single well, compliance costs for direct testing expenses is likely to cost between $2,500 to $3,000. These costs, however, are relatively modest when compared to indirect costs that are required.

Participation in the Diesel Pill Monitoring Program (DPMP) was estimated at $19,200 to spot a mineral oil pill, $26,500 for a diesel pill and $116,300 for hauling a pill-contaminated mud system to shore. A figure of $180,000 is also quoted in the permit as a typical cost for hauling a mud system to shore for disposal. This estimate was based on a volume of 5,400 bbl of drilling fluid, the use of two boats over 20 days drilling time and land disposal costs of $11 per bbl of waste. The cost was estimated by EPA to be less than 5% of the total well costs, which EPA believed to be "reasonable and economically achievable." Costs reported in the literature generally agree with the $180,000 estimate, but indicate deeper wells, longer drilling times and further distances to shore can increase this estimate.

Regardless of the exact and indirect cost estimates, the new permit will be a significant factor in drilling decisions, particularly for smaller firms. □

to give EPA and the industry data on the efficiency of recovering diesel pills.

The second limitation is by far the most troublesome for the industry.

Under the new permit, the EPA has set a minimum mud toxicity limit of 30,000 ppm Suspended Particle Phase (SPP) 96-hour LC50 for all discharged muds.

The new toxicity limit is both a daily and monthly average minimum, so in effect it requires the mud never drop below 30,000 ppm SPP on the bioassay test. At least one mud sample is required for each and every well drilled - an end-of-the-well sample. More samples may be required if the drilling period occurs over two calendar months, because a monthly sample is required for each well that has not reached total depth by the end of the month.

If the operator knows in advance that the proposed mud system will not meet the toxicity limitation, an alternative toxicity limitation may be requested. This request and all supporting data must be reviewed by the EPA 60 days in advance of discharging. Supporting data includes bioassay results of a lab-formulated mud containing the mud additives at the maximum concentration, the chemical characterization of the mud additive, well information, costs of the proposed mud system relative to barging costs and data supporting the use of this mud system relative to other muds known to pass the toxicity limit.

Other permit requirements for drilling mud discharge include reporting the estimated volume of mud discharged monthly and the oil content using the API Oil/Water Retort (daily). An inventory of mud products must also be maintained with volumes or weights of each compound added recorded.

The discharge of drilling fluids is limited to 1,000 bbl/hr (maximum hourly rate). Lastly, if the well is to be drilled close to a biologically sensitive area as defined by the MMS, EPA or the states, then the discharge rate must be controlled using the following formula.

$$R = 10^{[3 \log (\frac{d}{15} + T_t]}$$

where R = discharge rate (bbl/hr)

d = distance (meters) from the boundary of the environmentally sensitive area

T_t = toxicity-based discharge term calculated from the following equation:

$$T_t = \frac{[\log (LC50 \times 0.000008]}{0.3657}$$

The equation was written incorrectly throughout the permit and fact sheet: Tt should be added rather than subtracted. If using a mud with a LC50 equal to 30,000 ppm SPP, the distance from an area of biological concern must be greater than 544 meters to avoid the additional control.

Areas of biological concern, meaning those areas which contain marine or estuary communities thought to be sensitive to drilling discharge, have been identified by the MMS in the lease stipulation and now include the territorial seas of Mississippi. If the lease stipulation requires shunting to the bottom, the discharge rate limitation does not apply. No discharges are allowed within an area of biological concern.

Drill cuttings must not contain any free oil as measured by the receiving water sheen test and can be discharged only when observations are possible.

Discharge of cuttings from an oil-based mud is absolutely prohibited regardless of any type of treatment. While not stated, but announced in the New Orleans workshop, the discharge of cuttings from wells where the mud failed the toxicity limit would also be prohibited because of the adhering drilling fluid. Presumably, if the mud was washed off the cuttings, then discharge would be permitted.

Produced water

Produced water is dischargeable under the permits if it can meet the oil and grease limitation of 72 mg/l daily maximum and a 48 mg/l monthly average. At least one monthly sample is required, but more can be taken to determine compliance.

The technology to be used to meet with limitation is at the discretion of the operator. This limitation is a change from the previous permit due to the inclusion of the monthly limitation, which in effect, creates a new daily limitation of 48 mg/l from a practical and statistical sense. In other words, for every value between 48 and 72 mg/l recorded, a value equally distant or greater from the 48 average must be recorded in order to yield a monthly average of 48 mg/l. Since it will be impossible to predict an averaging out of these fluctuations accu-

rately, the operator is advised to consider 48 mg/l as the daily maximum to ensure compliance. An estimate must also be made for the volume of produced water discharged.

Deck drainage

Deck drainage and other miscellaneous discharges, including produced sands. well treatment fluids, completion or workover fluids, desalination unit discharges, ballast and bilge water, blowout preventor fluid and boiler blowdown water, are all regulated.

These discharges may not create a sheen on the receiving water and observations must be made daily. Standards are also set for sanitary and domestic wastes. Furthermore, no floating solids or visible foam on the surface of the ocean is allowed.

General conditions

The general conditions of this permit are very similar to previously issued general permits. The permits cover all oil and gas operations seaward of the state waters in the Gulf.

Violations of the permit are subject to fines not exceeding $10,000 daily unless determined to be willfull or negligent, which are subject to up to $25,000 a day fine and one year in jail, or both. Tampering or alteration of records is subject to $10,000 per violation and up to six months imprisonment, or both.

Records must be maintained for at least three years. Reportable data must be reported by lease block on the discharge monitoring report form provided by the agency. All applications and reports must be signed by a responsible officer of the company.

Recommendations for compliance

For several of the permit requirements, there is an inadequate database to assure compliance. The toxicity limitation is the best example of the industry's dilemma.

LC50 essential element to new Gulf mud permits

The EPA permit requires a bioassay be performed on discharged muds with the toxicity being expressed as a LC50. While this is not a familiar term to most in industry, an understanding of the LC50 is now essential.

A bioassay is a laboratory test designed to measure the effect of a chemical, or potential pollutant, on a species of animal or plant or an entire biological community.

For studying drilling fluids, the EPA has determined the mysid shrimp *(Mysidopsis bahia)* is the best available indicator species for the marine environment of the Gulf of Mexico. The mysid shrimp occurs naturally in the shallow estuary areas along the Gulf Coast. It also can be cultured in the laboratory yearround.

The mysid shrimp also has a relatively short life-span of approximately 30 days, so lifetime and multiple generation studies can be performed.

Bioassays measure the effect that a pollutant or chemical has on the selected species. For drilling fluids, lethality is the end point chosen by the EPA, rather than a sublethal end point, such as respiratory change, because it is easier to measure.

In order to quantify lethality, a group of organisms (60 shrimp per concentration) are exposed to selected concentrations (100%, 75%, 50%, 25% and 10%) of the test material for a defined period, i.e., 96 hours. The tests are conducted under rigid conditions, regulating such things as temperature and salinity.

The basic premise behind the test is that for every increment in dose or concentration above a threshold limit, there is measurable change. The concentration at which 50% of the test population responds is known as lethal concentration 50%, or LC50.

Fifty percent was chosen as the level of sensitivity, because the EPA reasoned this would adequately protect the environment. It represents the response of the "average mysid shrimp." The following figure demonstrates how the data points are plotted in order to calculate a 96-hour LC50.

The drilling fluid is prepared as a Suspended Particulate Phase (SPP) for bioassay testing, because it physically and chemically represents how the mud will behave in the marine environment.

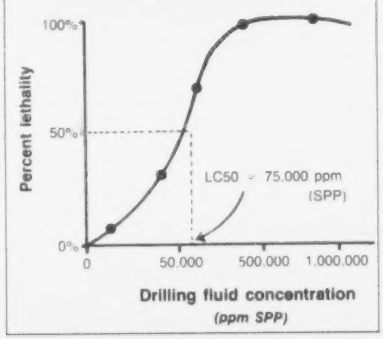
The mud is added to nine parts seawater and stirred for 30 minutes, allowed to settle for one hour and the liquid portion is then separated from the solids. The liquid portion, or SPP, is used in the bioassay.

The pure SPP equals 100% and is diluted again with seawater to make various concentrations for the test. The concentrations are chosen in order to obtain lethality at points above and below the 50% level in order to plot the curve.

LC50 is a confusing term, but is inversely proportional to toxicity because of the way it is expressed. For example, a high LC50 number, such as 500,000 ppm SPP, indicates relatively low toxicity since it took large concentrations of the test material to kill 50% of the test shrimp. Conversely, a low number, such as 5,000 ppm SPP, means relatively high toxicity because a small amount of test material was required to kill half the test population.

The new permit requires the discharged drilling fluid have a 96-hour LC50 to mysid shrimp greater than 30,000 ppm SPP. In other words, the permit has established a minimum standard or limitation and the mud must not go below that limit. □

Plotting data points for calculating 96-hour LC50



Even for those requirements for which enough scientific or operational knowledge is present, there is a shortage of well informed, trained personnel to assure compliance. For these reasons, it is suggested that each permittee adopt a very conservative approach for an interim period after the permit is effective. After a company regularly demonstrates compliance, then a less costly and time consuming approach could be instituted.

The toxicity limit is of the greatest concern to the industry. Operating personnel are totally unfamiliar with toxicity concepts and will have to be retrained to think in terms of toxicity. The mud companies have an inadequate database and lack trained personnel to adequately help fill the void. A significant effort will be required to comply with this provision.

The existing database is not encouraging. Of 80 field muds run in one laboratory in the past 10 months, 35% of the muds failed the 30,000 ppm limit. Twenty percent of 44 mud products registered with the EPA Region IX office through 1985 also failed the 30,000 ppm limit.

Certain functional categories, such as defoamers, lubricants, oxygen scavengers, corrosion inhibitors and miscellaneous commercial chemicals often failed the limit.

Several mud types, such as KCl, gyp and lime, have frequently failed the limits or are borderline when field samples are tested without any apparent reason. These facts suggest this area should receive the greatest attention.

It should be recognized that the EPA has abandoned the concept of generic muds in this permit and a clearinghouse approach for approval of mud additives. EPA reasoned it needed to afford the operator maximum flexibility in their choice of mud types and products. Also the EPA did not have adequate staff to review the data on individual mud products and believed that approval of additives constituted preapproval of the discharge - a legally unacceptable concept in the Clean Water Act.

While the EPA's approach fosters operational flexibility, it unfortunately does not afford an apparent mechanism to ensure compliance. Each operator will be responsible for gathering and evaluating data on mud products from the service companies. The quality of this data will not be consistently evaluated because each operator is apt to develop their own specific criteria and procedures.

Most operators do not have staff that is adequately trained in aquatic toxicology and mud formulation to assure compliance. There does not appear to be a mechanism by which information and experience obtained by one company will be available to another company. In lieu of this mechanism, the following recommendations have been made as a basis for compliance.

Sampling strategy

It is recommended an extensive mud sampling strategy be implemented. Frequent samples (e.g., every 1-3 days) will allow the permittee to detect possible causes of problems should they occur.

Not all samples should be analyzed, but the samples should be stored for possible analysis. Samples should be collected in specially cleaned and designated containers only to avoid contamination and shipped without delay under cooled conditions. The samples should be taken only during drilling from under the shale shaker and only after any added mud products have had adequate time to react and be uniformly distributed (i.e., 1-2 complete circulations). For critical samples (i.e., before spotting, end of well) duplicate samples should be kept on the rig under refrigeration until the lab has received the sample for analysis.

A chain of custody sheet should be completed and accompany the samples from the time of sampling until analyzed. The sample should be tested for pH before leaving the rig to adequately certify it was an acceptable sample under EPA protocol.

Sample analysis

Because the permit limitations are expressed as both a daily and monthly limitation, it is advisable to test at least one or two samples in additon to the end-of-the-well sample. Samples from the spud mud or lightly treated system will help average out any low values detected at total depth.

The EPA has suggested this strategy in the permit, so it is not an illegal or unethical practice. Analysis of samples at roughly 1/3 and 2/3 of the total depth, plus the end-of-the-well sample, would appear to be best unless the well is exceptionally deep, subjected to high temperatures, or operationally difficult and requiring a complete mud.

Select a laboratory for the analysis that is familiar with the drilling fluids bioassay protocol and is experienced in running those tests. Particular attention should be paid to the health of the mysid shrimp and to make certain they are *Mysidopsis bahia* and not other species. While other species may yield acceptable data, the EPA is quite specific in the bioassay protocol.

Enforcement guidelines needed to avert problems

Much of the enforcement responsibilities for the new Gulf of Mexico discharge permits will be shifted to the Minerals Management Service of the U.S. Department of the Interior.

Recognizing its lack of enforcement officers, the Environmental Protection Agency has entered into a Memorandum of Understanding with the MMS which authorizes the agency to assist the EPA in enforcement. The U.S. Coast Guard also will be charged with looking for sheens in the water.

"While there appears to be a core group responsible for enforcement, there have been no attempts to adequately train all enforcement personnel as to the subtleties of the permit," says Maurice Jones, vice president of the Southern Region of ENESCO Inc. of Houston. "How the various inspectors will interpret sheen on the water and bad weather, for instance, is apt to be questionable and inconsistent unless adequate guidelines are given."

One grey area which may be questionable is the presence of a sheen due to contamination of the drilling mud by crude oil from the formation rather than diesel oil. The EPA says that unavoidable crude oil additions to the mud would be acceptable, but added the burden of proof lies with the operator. □

Simplicity in the formulation of the mud program is the key to compliance. Proposed mud programs should be as simple as possible and still be functional. Each mud additive should be identified and chemically described to assist the operator in determining toxicity. Products to handle specific problems should also be identified in advance.

The addition of unnecessary special additives as a quick fix at the rig will only jeopardize compliance. Wherever possible, a mechanical solution should be tried to solve mud problems, before attempting a chemical solution. For instance, most foaming problems are caused by improperly placed suction lines, nozzles or mixers. Rather than add large amounts of defoamers, re-engineer the system to avoid foaming. When foaming does occur unexpectably, add minimal amounts of the product. Samples of the mud should be taken before and after the addition should toxicity drop below the limit at a later time.

The compliance process should begin with the proposed mud program. Review the toxicity data for all proposed products. If the data for all proposed products are of equal quality and comparable, select those products with the less toxic attributes. In order to maintain a safety margin between the toxicity of the discharged mud and the present limit, select a criteria appreciably higher than the limit. A cut-off point of 100,000 ppm SPP should be adequate to assure compliance.

Whenever possible, make this selection of a single company's product line rather than selecting products from several mud companies. The operator, therefore, will more likely be successful in assuring cooperation of the mud company should a mud fail by avoiding finger-pointing.

Ramifications

Several ramifications are immediately evident after reading the permit.

First, the mud companies and product manufacturers will be required to reveal more chemical information about their products than ever before. The tendency to reformulate a product under the same product name without notifying the customer should also be curtailed.

Once toxicity information is developed and distributed, the product composition must remain the same unless the toxicity of the new formulation can be demonstrated to be the same or it is marketed under a new name.

Product research and development can be expected to increase. Many of the products that failed the toxicity limit will need to be modified or replaced with other products. Operational changes are also likely. The purchase of liquid muds may be curtailed unless the mud company can certify its composition or toxicity to the satisfaction of the operator. A "certificate of toxicity" may become a common request in the oil patch now as a result of the permits.

As indicated earlier, certain functional categories (e.g. lubricants, defoamers, oxygen scavangers, corrosion inhibitors, biocides) are often toxic and will require product research.

Two procedures required by the EPA for compliance monitoring are noteworthy. To detect "free oil", the EPA decided to keep the traditional recovery water standard, no sheen on the surface of the water during discharge. Earlier plans to have a lab test that could be performed before discharge at the rig or back in the laboratory were withdrawn after criticism of the proposed bucket sheen test procedure. EPA did make the traditional standard more difficult by requiring all discharges be made only where a sheen could be seen if present. This amendment was in response to criticism by environmental groups that most discharges previously took place at night.

In the New Orleans workshop, EPA explained that discharges could still take place at night if the ocean is adequately illuminated. The operator should be aware that no field work has been done to determine whether night time observations are truly predictive. Should the sea calm during a night time discharge in a low current environment, the operator could be faced with a "sunrise suprise." A strategy that may be useful is to routinely perform a small discharge at dusk when a sheen can still be seen and record the observation. If a discharge is necessary that night, and no oil additions have been made during drilling, then the operator will have additional data to support his case should a problem arise. Documentation of the discharge with a camera and sworn statements of several observors may be prudent, particularly in the interim period of adjustment to the permits.

Research on the sheen test found that if a laboratory or bucket sheen test needs to be used either to screen products or actual field muds, then the Alaska (Region X) procedure was the most reproducible test of the three previously proposed procedures. These tests should be run under carefully controlled conditions in order to obtain any useful data. Surprisingly, mineral oil was more visible than diesel in those evaluations. Some differences were detected between observors depending on whether they had vision correction, any color blindness, or were smokers, although the variability was not statistically significant.

Variability due to different base clays, water type and type of oil could significantly change the results. Vibrations from the rig can also be a problem.

If the operator wishes to use the bucket sheen procedure for compliance, then a request must be made to EPA to approve the test. The operator can use the test without notification but for unofficial observations only.

Summary

Discharge permits issued by the EPA for oil and gas drilling and production in the Gulf of Mexico are significantly more stringent that previous permits. The changes are due to a shift from Best Conventional Technology and Best Practicable Technology to Best Available Economically Achievable Technology as required by the Clean Water Act. The EPA and environmental groups are greatly concerned about the impact of drilling discharges and produced water on the marine and estuarine ecosystems.

Most of the controversy has centered on products used in formulating drilling fluids and the new toxcity limit for muds has proven to be the most difficult aspect of the permit. A failure rate of 35% to 40% for field muds tested in the last 10 to 12 months suggests that significant product and operational changes will be required to ensure compliance.

Retraining of personnel

Retraining of personnel will be essential, as well as the development of certain controls (e.g., purchase of approved products only). The cost impacts of the permit will be felt by all,

especially as required to retrofit older platforms to achieve the oil and grease limitation. Other significant costs will be incurred if muds have to be barged to shore for onshore disposal. The drilling fluid product manufacturers and mud companies with coastal operations will also be faced with significant testing costs for products and direct losses if current liquid mud stocks are unacceptable.

The greatest cost impact, however, will be felt by the manufacturers of cuttings washer and treatment equipment. Under the permit, this equipment is no longer allowed, except to possibly wash cuttings from a water-based mud that is failing the toxicity limitation or to transport cutting across the rig for disposal.

The costs of compliance with the permits, however, may be somewhat lessened by savings in the total mud bill. That is, if numerous specialty additives are going to be used in lower concentrations or not at all, the operator may see a significant decrease in mud bills. This assumes that prices of acceptable products remain constant, which is likely to be the case for the remainder of the mud depression. It also assumes the modification of products or product substitutions result in products of comparable costs. Development costs, or the need for purer, higher technical grade products may drive prices up somewhat for those products that are eventually proven acceptable, but the overall costs will not significantly increase because the largest volume products, such as barite and bentonite, are not in question.

The permits will create some marketing opportunities (e.g., testing labs, disposal companies and new products), but the overall impact will be increased costs for all segements of the industry. Whether significant environmental benefits will be accrued because of these permits is yet to be seen and will occur only if significant changes can be accomplished without affecting drilling and production. □

Author

Maurice Jones *is vice president of ERCO, a division of ENSECO Inc. of Houston, which is a nationwide environmental consulting firm. Jones, a certified professional ecologist, was formerly president of Maurice Jones and Associates of Houston. Jones previously was the manager of environment, health and safety for IMCO Services, a drilling fluids company.*

Offshore
INTERNATIONAL JOURNAL OF OCEAN BUSINESS

EDITORIAL

Good news, bad news scenario

Futurist John Naisbitt offered the petroleum industry some of his observations on the pressures businesses are experiencing today in a talk before a recent meeting of the Society of Exploration Geophysicists. While disputes may arise over the accuracy or importance of some of his observations, his comments make interesting discussion:

- The world is ganging up all types of industries everywhere, not just the petroleum business, and forcing each industry to re-examine what it does for society.
- With a global economy forming, it may become politically acceptable for one or more areas of the world to produce goods or resources when it can do so much more economically than anywhere else. (Energy independence advocates sharply disagreed here)
- Supplies or reserves of resources and minerals are in permanent oversupply, induced by declining populations and relatively smaller quantities of resources needed to accomplish the same tasks. This is only a partially-baked theory so far, Naisbitt claims, but one with ma or significance if he is right.

The good news on this last point is that hydrocarbon's share of the total energy pie is increasing, since no other energy form can compete economically.

Naisbitt stated further that economists miss with forecasts because they ignore the entreprenuers in industry. And fortunately, he claims, the entrepreneueurs ignore the economists.

Concerning education, he went on to say that an information-intensive society is being penalized by poor educational systems and institutions, and these are most in need of change.

On the formation of global economies, Nasibitt claims countries are reprivatizing industry everywhere. Soccialist countries are realizing that entitlement or welfare - based economies are not competitive.

On company management, he says that businesses need to develop a strategic vision first or any kind of strategic planning is a wasted exercise. He suggests that companies examine the larger context of the niche or industry they serve.

An encouraging point is that he asks companies and individuals not to abandon the businesses they are in and the purposes in society they serve, but to examine these and be open to change when it becomes necessary. While Naisbitt's observations are subject to disagreement, and certainly revision as time goes along, it is interesting to note that some of his past observations (information and computers) are already coming about. □

1987 OUTLOOK

New crude discoveries in the deepwater
major development projects in the 1985-86
towed out to the East Breaks area from
City.

The first oil production from Britoil's
UK sector of the North Sea is expecte
structure was installed in 1986 and hook
on the structure.

Early '87 to see more of the same

DISMAL CONDITIONS experienced this year in all segments of the worldwide offshore drilling and production industry are expected to continue well into 1987.

While most industry analysts are quietly confident the price of a barrel of oil will begin to move upward and perhaps stabilize by the second half of the new year, few believe there will be any good news for the first six months. Furthermore, many say operators, who are fortunate enough to pull together enough cash to drill a well, will concentrate more on development while turning up their noses at the sinking of rank wildcat prospects. The exception may be the Gulf of Mexico, which could see a rebound in exploration drilling by the second half of 1987 as operators scramble to avoid turning valuable leases back to the U.S. government.

Overall, however, operators will be more secure and develop known regions, rather than risking valuable cash on high-risk propositions.

"Because of the price volatility and the conservative tendencies it generates, we expect to see a trend toward marginal step-out development. This means additional development in proximity to an oil company's existing areas of development," says Robert E. Howson, president and chief operating officer of McDermott Marine Construction, a subsidiary of McDermott International Inc.

"This trend would lessen the need for mobilization and eliminate the establishment of a new infrastructure. The field could be developed on an incremental basis, using floating production and/or subsea completions," he added.

The use of floating production and subsea systems has become synonymous with Brazil, which has the distinction of being the world leader in deepwater exploration and production. Brazil was one of the few bright spots this year and aggressive state-company Petroras promises the deep water exploration push will continue in 1987, despite significant and much cheaper onshore discoveries.

"Brazil will sustain its high levels of investments on offshore operations," affirms Wagner Freire, vice president of Petrobras subsidiary Braspetro. "In 1987 and subsequent years, Brazilian forecasts for the offshore operations call for the maintaining of 40 drilling units working on exploratory and field development activities and 10 to 14 acting as stationary units on floating production systems or running workover operations."

Freire believes the high success rate in the deeper waters of Brazil and the Gulf of Mexico may force operators to look more closely at investing in the frontier projects, which are becoming less of a financial risk with the technological advances being made in recent years.

The technology breakthroughs recorded over the past few years may make all frontier areas more attractive, despite the gloomy oil price outlook. The arctic, for instance, may contain as much as 40% of the world's recoverable oil and gas reserves, says a Finnish researcher. While that oil is not worth removing under today's price structure, it will become economical once evolving technology further lowers the finding costs.

"While the development of new offshore fields in the north (arctic) is primarily controlled by the oil price, there is no reason to overreact to the situation," says Pauli Jumppanen, director of research and development for Wartsila Ab of Finland. "New technology in drilling, production and transportation can decrease total costs by 10 to 30%. Then the exploitation of hydrocarbons in the sub-arctic and arctic waters can possibly take place earlier than we expected today."

Exploration and development drilling are expected to gradually increase by the third quarter, but no one believes a supply and demand equilibrium is likely for the near term. While some say it will take $25 to $30 bbl oil to prompt orderly activity, others say a lower, but stabilized, price will suffice.

"Provided OPEC is able to restrict production sufficiently to achieve a price level of $15 to $20 bbl, exploration will start picking up in 1987 and a near-balanced rig supply and demand situation for North Sea jackups and semis will emerge in 1988-89, while the U.S. Gulf may need another couple of years," says Magne Reed, managing director of Norway's Dyvi Offshore A.S.

McDermott's Howson added the next year will probably be, what he terms, "a lean year" for the marine construction industry.

"By 1989, we hope to see contiuned improvement as prices edge higher, gas markets firm, and companies feel confident enough to make investments," he said.

On the following pages, *Offshore's* editorial advisors give their impressions of what to expect in the drilling, production, construction, transportation, seismic, research, diving and advanced technology sectors of this rapidly changing industry. □

Wagner Freire

Wagner Freire is president of Braspetro, a subsidiary of Brazil's state company Petrobras. He joined Petrobras as a geologist in 1958, before being elevated to head of the geophysics division. Freire later became an executive vice president of Braspetro. He holds an engineering degree from the University of Rio de Janeiro.

Oilmen to face uncertain years ahead

THE INSTABILITY and uncertainties of the oil price and world consumption profile will characterize the petroleum market for the next three years.

The "Brent" type crude will maintain its quotation in the range of $15 to $20 bbl with investors being hard pressed to increase exploration and field development budgets.

Low rates of return and lack of current cash flow to finance new projects will lead the major companies to search for cost effective solutions to their especially challenging deepwater prospects.

Floating production systems, coupled with subsea completions and underwater production manifolds, will become the most attractive solutions for the economics of medium and deep water offshore projects. Those types of field developments will support a reasonable number of semisubmersible rigs, which can be converted to floating production units. Typical cases are the deepwater developments in the Campos Basin of Brazil and Placid projects in the deepwater Gulf of Mexico. Additionally, there is growing interest in India, Indonesia, Australia, China, the UK, and Norway towards deepwater prospects.

The discoveries of giant fields in the continental shelf of Brazil, along with some smaller fields in the Gulf of Mexico, should prompt the majors to increase the amount of investments in exploration targets aimed at oil and gas discoveries in turbidite sands of the upper tertiary. These prospects will improve the rig count of dynamic positioning drillships and semisubmersibles.

A set of operator incentives also are envisioned from the governments of western Africa and several other countries, in order to make the concessions or joint ventures to explore "turbidite model plays" along their continental shelves feasible.

The "field proved" procedures and equipment being used in medium water depth wells may become standard designs and practices for the completion of deepwater wells and their connection to floating production systems.

Brazil, for one, will sustain its high level of investments on offshore operations. Such a decision is supported by the outstanding rate of success already enjoyed, as well as it fits the necessity of increasing both the reserves/production and reserves/consumption ratio.

The Brazilian economy has grown at extraordinary rates since last March as a consequence of a program for economic stabilization implemented by President Jose Sarney. From January to September of 1986, Brazil's domestic consumption of petroleum products gained 11% over that of a comparable period a year ago.

In 1987 and subsequent years Brazil's forecast for the offshore operations is to maintain 40 drilling platforms working on exploratory and field development activities and 10 to 14 units serving as stationary units on floating production systems, or running workover operations.

Governments' incentives will play a very important role in stimulating new investments. Norway is a good example. The introduction of some measures in the licensing terms, such as the cancellation of the carry-over of Statoil, the elimination of royalty and the decrease in the charge for geophysical data, has motivated a very favorable response of the oil companies with 21 applications on the 11th round. Braspetro is applying for the first time.

Drilling practices and equipment have been gradually improved, allowing better penetration rates, the lowering of rig down-time by using MWD logging tools and seismic well logs. Well costs, therefore, are decreasing accordingly and are expected to continue for the foreseeable future.

Seismic 3D data acquisition and interpretation techniques are also contributing to the more inexpensive economics of the exploration and field developments, both onshore and offshore.

In conclusion, I believe the cooperative work of foreign and Brazilian companies will in the near term provide the technology for deepwater oil and gas production and encourage petroleum companies to invest firmly in the exploration for hydrocarbon reserves in new deep water frontiers. □

Magne Reed

Magne Reed, managing director Dyvi Offshore A.S, is a graduate of the Norwegian University School of Business Administration. Before joining Dyvi Offshore, the former president of the Norwegian Offshore Association was minister of Norway's Permanent Mission in Geneva from 1966–1972, and ambassador council of Europe between 1972–1973.

Hike in drilling possible for 1987

PROVIDING OPEC manages to restrict production to achieve a price level of $15 to $20 bbl, I believe exploration will start picking up next year. Furthermore, I predict a near balance in the rig demand and supply situation for North Sea jackups and semis will emerge in 1988/89, while the U.S. Gulf may need another couple of years.

However, I'm particularly concerned about the future of the offshore industry that has developed around the North Sea.

In the last 15 years, the North Sea has developed into one of the major frontier areas in terms of drilling activity. The level peaked in 1985 with more than 100 semisubmersibles and jackups working around the U.K., Dutch, German, Danish and Norwegian continental shelves. This market has attracted both regional contractors and a large number of foreign, mostly American drilling contractors.

In view of the harsh environment and consequently stringent national regulatory body requirements, contractors had to develop advanced designs in terms of deckload, water depth and stability requirements.

Tragic accidents have made authorities particularly concerned about the security of installations. The oil price increases of 1979 through 1981 created a demand for new rigs that could fulfill these requirements and subsequently back-to-back deals were made in terms of long-term drilling contracts for newbuildings. Some of these rigs are still operating.

In the last six months, the market in the North Sea has changed dramatically with only about 50% of the activity levels of last year. Day rates have tumbled for both jackups and semisubmersibles.

Meanwhile, there exists a strong feeling in the European theater that some U.S. drilling contractors are driving prices down to a level well below what is required to keep units safely operating and adequately maintained. European concerns are suspicious that American drilling contractors are trying to run the weaker local companies out of the market. If this trend continues, it is conceivable that strong protective measures may be taken by several European countries.

The offshore mobile drilling industry is dependent on its mobility. If governments are forced to take protective measures to defend the interests of their national drilling industries, this can only harm international drilling contractors in the long run.

The American drilling contractor has always dominated both onshore and offshore activities. The U.S. companies have a long tradition of efficient operations, large manufacturing industries supporting these industries and very professional crews. Europeans remain relative newcomers in the industry, but today still can provide the industry with designs both for offshore installations, drilling equipment and the manpower at all levels, which on this side of the Atlantic has carried forward the American heritage.

The offshore service industry depends on the ability and interest of oil companies to explore. But the industry also depends on our ability to dig deeper into the actual production of oil. American companies like Transworld have shown the way in the North Sea of floating production installations.

With smaller reservoirs and deeper water and lower oil prices, subsea installations with floating production units carrying the production facilities are viable alternatives to the "cathedrals" of Statfjord, Oseberg and Gullfaks. This may give drilling contractors a new role. In the present depressed price scenario we may have to do with the "village church," or much smaller and less glamorous production schemes. Within the larger European drilling contractor groups today, one finds engineering firms offering total project schemes that provide the answers to this demand.

The offshore industry has a clearly defined future. More oil and gas supplies must be found. At present, the oil companies rely on outside service contractors to do much of this exploration, particularly in the service and supply segments. In the future, drilling contractors may need to widen their capabilities and offer more than a drilling service. □

Robert E. Howson is president and chief operating officer of the McDermott Marine Construction unit of McDermott International, Inc. He joined McDermott in 1957 and was later named chief engineer for the offshore division. He holds a B.S. degree in civil engineering from Louisiana Tech University and a masters degree from Tulane University.

Robert E. Howson

New technology key to market

FOR THE OIL and gas industry, 1986 has been a year of adjustment and transition into a new environment. And the new environment will not be nearly as comfortable or predictable as it was in the past.

In the last nine months, the oil price has dropped between 40% and 50%, with the mobile rig activity worldwide following with a decline of about 35%. That figure already was down 7% from the January 1985 peak.

To forecast the outlook for marine construction activity, one first needs to look at the future from the customers' perspective.

The three main factors, which all oil and gas companies are evaluating today, are prices, cost and taxes.

Forecasting oil prices at the moment is akin to shooting dice. Most companies are operating with three basic scenarios:

Optimistic: OPEC keeps a tight production quota which allows prices to rise back to the $20 bbl in the next couple of years.

Middle ground: OPEC manipulates production so prices stay at $15-18 bbl at least until 1990. A high degree of volatility is associated with this forecast.

Pessimistic: OPEC falls completely apart, which increases production and prices drop back to the $8-10 bbl range.

We have been painfully reminded that a very few countries have enough cheap reserves to drastically affect oil prices by altering production. Given the great uncertainty that a cartel will be able to effectively control prices, most companies are conservatively using some combination of the middle ground and the pessimistic scenarios for decision making. In some cases, the cutoff rates for development projects is simply a flat $15 bbl, or lower.

Given the low oil price outlook, the costs of development in different geographical areas is driving the marine construction market. In all areas of the world, we have seen a serious decline in the expected level of activity for 1987. Obviously, a number of projects which were conceived under $27 bbl oil are no longer economic.

Some areas, such as Alaska, Canada, and parts of the UK North Sea, have a combination of development costs and reserve size which makes it difficult for a company to project an adequate return on investment.

Deepwater development has been put on hold as companies re-evaluate how costs could be cut to change the investment picture and increase projected cash flow. They are examining their options much more closely now, investing in detailed feasibility studies before making decisions on how to proceed.

The lower cost areas, such as southeast Asia, Middle East and West Africa, have been less impacted by the oil price decline, but are suffering from a lack of cash available for development.

The use of a tax policy is the most direct way a government can influence the attractiveness of oil and gas development in its area. The new Norwegian proposals, for example, are credited with cementing the go-ahead of the huge Troll gas project. In the northern UK area, however, it appears the economics are so unfavorable that tax changes would have a minimum impact. More global movement on this front is expected during 1987, as all governments adjust to the idea that prices can go down, as well as up, and re-evaluate their tax policies.

One trend I expect to see is that of "marginal stepouts." This is development near a company's existing fields. If this occurs, there's less need for mobilization costs or establishig supply lines. Fields could then be developed in stages, using floating production or subsea completions.

In response to a changing market environment, an offshore service company's growth, or possibly even its survival, will depend on its ability to conform services to fit the specific needs of each field and each operating company.

Alternate schemes of development are being closely examined by oil companies. Fixed platforms, compliant structures, hybrid structures, floating production systems, and subsea production systems are being evaluated, both technically and economically. Since there are fewer opportunities, new technology is the key.□

Svein Kjellesvik

Svein Kjellesvik is president of GECO Geophysical Co. Inc. operations in the U.S. and Canada. He previously served as senior vice president of marketing and seismic operations at the Oslo, Norway headquarters. Kjellesvik has also served as general manager of GECO Singapore. He received a M.S. degree from the Norwegian Institute of Technology.

Innovations permit firms to survive

TO EVALUATE the future of the geophysical industry, it is necessary to look at what has happened the last three years. This industry has been in a difficult situation since early 1983 as most geophysical companies have posted large losses throughout these years and their capital base has eroded.

However, in contradiction to the difficult market situation, a few contractors have introduced significant technological innovations during the last two to three years. The most important are:

Two streamer 3-D surveys:

This technique makes it possible to shoot two seismic lines by one traverse of the seismic vessel. This doubling of productivity has made it possible to economize the acquisition of 3-D data.

Cost has been the major factor keeping oil companies from doing 3-dimensional surveys.

Use of super computers:

Leading geophysical contractors have now installed Vector Processors in their computer centers These units provide enormous computing power for more accurate treatment of offshore seismic data. In most types of geophysical data processing, there is a tradeoff between processing cost and data quality.

With the introduction of the vector processor, geophysical contractors can provide new and sophisticated computations and analyses at very low prices.

Interactive workstations for geologists and geophysicists:

These systems make it possible for the geoscientists to analyze and interpret the seismic data on high resolution screens instead of on paper sections. The interpretations can be readily off-loaded to data bases and mapping systems. Thus, an exploration staff can go through full evaluation of prospects and generate maps in a matter of days. The productivity of the geoscientist increases and his time is used for creative work since the workstation is covering the time-consuming work of data handling, posting and mapping.

Most contractors have through the three previous years accrued heavy debts and are financially weak. Contractors who want to stay in business have to make large investments within the next one to two years.

As before, the geophysical contractors will have to adjust their capacity and investments to the needs of the oil companies. The market will be very volatile and it will challenge the contractor's ability to adapt to quick increases and decreases in demand.

Geophysical spending will be a bigger share of the oil companies' exploration budget.

This is a positive sign, but acquisition capacity per vessel will increase by a factor of two through the implementation of two streamer technology on the vessels. This points toward a significant reduction of the worlds' seismic fleet.

Inherent in the dramatic fleet reduction is a significant change in fleet quality. The vessels surviving the shakeout will be large (250 ft plus). The majority will tow two seismic streamers. They will have large airgun capacity and 480 recording channels.

The vessels will stay at sea for six months a year with crew changes carried out by helicopters.

Facilities will exist to use energy sources other than airguns. The key alternative will be vibrating sources. These have already been used in the North Sea offshore arena and offer benefits not available from other sources.

The processing of marine seismic data will be centralized. A few large processing houses with super computers will handle the vast majority of the processing for many offshore projects.

Due to the available computer power, quality will be much improved. It is fair to assume that more quality improvement will be achieved the next two years than the last six to seven years.

The current financial difficulties combined with the stagnant market and large needs for investments in new vessel technology will cause a major restructuring of the offshore seismic industry. Through mergers and bankruptcies, the number of contractors will be reduced by a factor of three and the high technology threshold will also mean very few few companies entering the market to collect and process seismic. □

John Huff was named president and chief executive officer of Oceaneering International Inc. in August. He previously served as president and chairman of Western Oceanic Inc. and later helped found Falcon Partners, an investment banking group. Huff holds a bachelor's degree in civil engineering from Georgia Tech University.

John Huff

Diving industry expected to see flat '87

THE 1985 DIVING FORECAST began with a cry to "circle the wagons" and concluded that the underwater services industry "is just trying to keep the lights burning." Unfortunately, this year's story is much the same.

Pricing is still down, and demand remains weak. The number of underwater services contractors will continue to fall through 1987, and eventually, there will be only two or three major international competitors.

With fewer contractors, supply and demand for underwater services will come into balance, allowing for an increase in prices, especially for remotely operated vehicles and other high-technology services. However, this may not occur during 1987, and margins may never be as large as they once were. The underwater services market will be a viable industry, but it is highly unlikely that there will see a return to the "boom days."

However, any predictions made about the 1987 underwater services market will be accurate only to the extent that we can forecast the price of oil, and this is a risky undertaking at best. Therefore, this year's outlook focuses on those areas of activity which may be promising for the surviving underwater service companies – operationally, geographically, and technologically.

With many major producers delaying exploration and development programs, we may see a near-term shift in emphasis of many underwater service contractors from drilling support to supporting production more cost-effectively.

Overall, the worldwide market for underwater support services will probably be flat in 1987. However, one area that has potential for an increase in activity is inspection, maintenance, and repair (IMR). At least 60% of the world's oil and gas fields are in the production phase of development. Since many of last year's programs were deferred, 1987 may see some "catch-up" inspection and repair work.

Another area of potential growth will be platform salvage. In the U.K., platform decommissioning guidelines are being actively considered, and the U.S. National Research Council estimates that there are 2,354 platforms in the Gulf of Mexico alone which will require salvage over the next 20 years. With new methods to remove platforms – without using explosives – being developed in response to environmental concerns, we expect increased platform salvage activity next season.

Geographically, there will still be small pockets of exploration and development activity around the world, generating traditional work opportunities for underwater services. In the U.S., deepwater tracts are still slated for development and, as lease terms expire, companies may be forced to accelerate activity.

Elsewhere, Brazil's Petrobras recently announced a total investment of DLR 12 billion in the 1986 to 1989 period, of which 90% will reportedly be spent on exploration and production.

There is other activity in South America, India, Australia, and Malaysia. China also seems to be making progress in reducing the disincentives for foreign participation in exploration.

Technologically, 1987 will continue to see the development of more sophisticated remote work systems and diver support systems. We are beginning to see a return to technical cooperation among customers, contractors, and manufacturers—cooperation that will be needed in the years to come.

The surviving underwater service contractors will be those that continue to stay on the cutting edge of technology, developing cost-effective systems to address operational needs in a variety of subsea environments.

There is little doubt that close attention to overheads and operating cost structures will continue to be important for our industry. We have learned too much about operating efficiencies to return to the overheads that characterized the "boom era".

Strategic assessment of each company's strengths and areas of competitive advantage will foster specialization in certain market niches, with research and development expenditures aimed at areas

Alan Jardine

Alan Jardine, senior consultant in the oil and gas division of PA Computers and Telecommunications, began his 20-year career in computing with Honeywell. He since has worked with Daniel Industries, Phillips Petroleum, and the Royal Dutch Meteorological Institute. He was qualified in computer science at Glasgow College of Technology.

Precision drilling, weight future concerns

NO-ONE NEEDS to be reminded of the devastating effect the fall in the price of oil has had on our industry since last March. Equally, everyone is cautiously optimistic that the oil price will recover to a reasonable level sometime in the present decade.

Industry experts, such as the now-deposed Arabian oil minister Sheikh Ahmed Yamani, have predicted another oil shortage and crisis in the early 1990's. Thus far, oil companies have curtailed speculative exploration and have trimmed their labor costs. The question many are asking is whether the operators will make use of the breathing space of the next few years to utilize advanced technology to respond to the predicted upturn competitively and efficiently.

Exploration and production companies, especially in the North Sea, are now looking closely at advanced technology. They are recognizing the benefits derived from the use of electronics, computers and control systems to plan the continuation of their development plans in the North Sea and other hazardous provinces. Surprisingly, it is the small to medium operators who are adapting more easily.

The technology used to develop the North Sea is in the vanguard of all offshore technology. Spurred by the need for domestic supplies in the 1970's, Norway and the UK faced the challenge of drilling and producing from hostile environments and in water depths of 130 meters to 400 meters.

The North Sea developments in electronics, computer and communications technologies supported the larger-scale and perhaps more visible advances. Significant developments include:

- Microprocessor-based metering instrumentation and microprocessor-based ultrasonic leak detection system;
- Remotely operated vehicles (ROVs) and high-resolution underwater television cameras;
- 3-Dimensional seismography;
- Advanced SCADA and distributed control system applications;
- Computerized inspection and maintenance techniques, among others.

Almost certainly, exploration and production of oil and natural gas will continue in the North Sea well into the next century. In addition, the United States will likely pursue deepwater possibilities and may well continue arctic exploration, even if at a slower rate. Lessons learned in the North Sea can do much to aid these operations.

Two recent publically-funded reports in the UK have identified the following technology areas as being the most critical to future growth. It is therefore possible to forecast what areas will be most vital in meeting future demands:

Precision exploration: digital data acquisition and transmission techniques to enable better oil strata resolution, higher capacity data channels from the sensors and artificial intelligence aids for interpretation.

Drilling and production: onboard computerized mud blending system; downhole acoustic telemetry systems; expert system based mud diagnosis; improved measurement-while-drill-ing techniques.

Systems and equipment for subsea production: better and more reliable hydraulic control systems; the advent of safe electrical telemetry for faster response times.

Subsea systems for maintenance and repair: smaller and lighter underwater television cameras and systems; on-vessel pattern recognition systems; inspection pigs with enhanced intelligence; a new generation of ROV's with improved reliability, speed and poor features and with intelligent acoustic and prosthetic subsystems.

Electronic tools for remote control and automation: distributed control systems with multikilometer data highways; improved control element reliability; integrated process control and management information systems; expert system aids for remote operators; slow-scan television systems.

Weight reduction: further developments in integrated CAD/CAE techniques for efficient topsides and jacket design; simulation models to control and reduce topsides equipment redundancy;

Kenneth Waldorf is chairman and chief executive officer of Zapata Gulf Marine Corp. He also served as president of both Zapata Off-Shore Co. and Zapata Marine Service, Inc. after leaving the marine department of Exxon Co. U.S.A. Waldorf is a U.S. Naval Academy graduate and holds an M.B.A. degree from the University of California.

Kenneth W. Waldorf

Old boats need to be retired from service

FEW THINGS ARE predictable in today's distressed offshore marketplace. One assertion, however, can be made with fair assurance: the demand for service vessels is not going to increase significantly for some time to come.

This does not necessarily mean the marine service industry will continue to languish as utilization rate percentages hang in the 50% range. If demand cannot be increased, necessary adjustments to supply will perhaps occur.

Zapata Gulf recently conducted a study of market trends for marine service vessels in the 165-ft and larger class. We chose that class because the company does not compete in any significant way at the smaller end of the market.

Our study showed if the world fleet remains at its present size of nearly 1,500 vessels, the supply and demand situation will remain unbalanced for the foreseeable future. If all tonnage 12 years or older is retired, supply and demand curves would meet in 1990.

This does not mean the day rates will suddenly skyrocket within a few years. What it does mean is if service vessel operators reduce their fleets now, the industry may be able to return to the point where companies can service debt and make a modest profit.

This certainly is a realistic assumption. Market forces are already prompting the removal of aging tonnage from the world fleet, either by scrapping or sale into noncompeting industries.

During the last fiscal year, for example, Zapata Gulf sold more than 40 boats. In the process, the average age of the fleet was lowered to just over eight years, which is perceived to be the right age to maximize the economic benefit of a marine fleet.

Some competitors have also been active in disposing of excess tonnage, but more companies need to do so. One significant stumbling block is the fact that there are a number of marine service operators who have fleets made up largely of older tonnage.

To them, as well as other members of the marine service industry, I pose a philosophical question: would you rather sink slowly beneath the waves an inch at a time, or take the plunge, cut away the dead wood and survive with a smaller, but viable operation? Dismantling a fleet that took a lifetime to build is a blow to the ego, but in this situation, it also makes common sense to do so.

Consolidation in the marine service industry, led in part by the triple merger that resulted in the formation of Zapata Gulf Marine Corp., is not going to play the role in changing the industry that was once thought. We were lucky we accomplished the Zapata Gulf merger when we did because the opportunities for further consolidations are being limited by the worsening debt structure of many leading candidates.

During the next year we will see additional bankruptcies as the shakeout continues. Many boat companies are operating at the break-even level, but unfortunately that anticipates a 100% utilization level when, in fact, they are actually working in the 50% range. Companies that are doing this are bleeding themselves of vital cash. This situation cannot continue.

Looking at the offshore supply-demand equation from a geographical perspective, no areas of the world show any strength except where offshore activities are operated by a state-owned company, like Petrobras in Brazil or ONGC in India. Even so, there is little relief for supply boat operators because of the mobility of the world's tonnage and the influence of world market prices. In fact, ONGC and Petrobras have shown themselves to be particularly adept at taking advantage of the prevailing market.

Market conditions resulted in a cooling of the technology explosion that swept through the boat industry a few years ago. As the price of oil declined, so did the enthusiasm of boat owners at building vessels for deep water and hostile operating environments such as arctic regions.

I believe the industry is putting the maximum emphasis on efficiency and safety in serving customers. Unfortunately, it is extremely difficult to maintain the high level of service at the rates that oil and construction companies are willing to pay. □

Pauli Jumppanen

Pauli Jumppanen is director of research and development for Finland's Wartsila AB. He also served as a research engineer for Technical University of Munich and director of the Structural Engineering Institute at the Technical Research Center of Finland. He holds a PhD in materials engineering from the Helsinki University of Technology.

New research helping lower arctic costs

THE DRAMATIC FALL in the price of oil and gas has severely impacted offshore development. The reduction or curtailment of exploration and development budgets has especially clouded the future of arctic petroleum exploitation.

According to most evaluations, northern and sub-arctic hydrocarbon developments pre-suppose an oil price higher than $20 bbl. While some attractive fields can be profitable in the $17 to $18 bbl range, prospects under ice-covered waters demand a price of at least $25 to $30 bbl.

About 45% of the world's recoverable oil and gas resources are estimated to be located in offshore fields and about 40% of those are in arctic regions. Arctic onshore exploration and production is, in most cases, as difficult and costly as offshore operations, meaning nearly half of the world's oil and gas reserves lie in extremely harsh environmental regions.

If sub-arctic and arctic hydrocarbon production becomes profitable in perhaps the late 1990's, increased exploration activity is inevitably needed now. The development of new technology and solutions should, therefore, be continued without gaps and large reductions. The arctic operations made so far have been very successful from the technical point of view. Basic efforts now should be aimed at making future northern oil and gas exploration and production cheaper and profitable.

New technology must increase at a rapid pace to meet this challenge. For example, the properties and behavior of annual and multiyear ice, as well as ice loads on structures, have been studied extensively in connection with arctic operations. Ice cover has been successfully used as a drilling platform and construction of ice roads and reinforced ice structures have been studied in detail.

While navigation in ice has become routine, latest developments show the capabilities of ice-breaking ships still can be improved by 20% to 50%.

The creation of an effective ice management program also can greatly extend the operational period, along with minimizing damage to drilling and production systems. Ice management combines both active and passive efforts to carry out operations in ice and includes designs for ice loads, forecast and warning systems for an ice situation, etc.

Harsh environment developments also have created more competition between the suppliers of construction materials. In addition to steel, concrete has been used as basic material for both exploration and production platforms. New concepts are comprised of steel or concrete, but more often these materials are combined or hybrid solutions utilized.

Sea water corrosion, cold temperature and special loadings have stimulated the development of special steels for sub-arctic and arctic offshore operations. For instance, aluminum with its high strength/weight ratio and low maintenance costs will be a potential competitor. New applications in cables, flexible risers, pipings and other special components, contain, for example, synthetic rubber, plastics and are still more progressive.

Elsewhere, prefabricated modules several 100 tons in weight already are being used in the shipbuilding and offshore industry. Construction in remote cold regions favors the use of still larger and heavier units both onshore and offshore. The so-called super modules with a weight of up to 10,000 to 20,000 tons have been discussed and used in the North Slope of Alaska.

Exploratory drilling in the arctic have been carried out by using ice cover, ice islands, artifical islands or caissons a supporting platforms. Exploration in sub-arctic waters is, in most cases, possible by using conventional methods during the ice-free period, but exploration and production from most areas of the arctic will require artifical islands or caisson-type structures.

In sub-arctic waters where the operational ice-free period varies from six to 12 months, floating production systems offer an alternative worth considering. The operational period can easily be extended by 10% to 30% by making an efficient ice management program. □

Boat survey indicates changing fleet

Slower activity in oil exploration and weak demand elsewhere contributed to a reduction in the number of boats reported in our annual survey of boats available in the petroleum fleet. This year's count totals 3,481, down from 5,258 in 1985, a drop of nearly 34%.

Where these missing boats went is not yet clear. Some were sold outside the petroleum fleet, and many were scrapped or scuttled due to age. But others may simply have changed ownership, moved to new locations or been reassigned to new duties.

Far fewer companies responded to our survey this year. The 1986 count is 187 boat firms, compared to 443 in 1985, 383 in 1984 and 397 in 1983. A telephone survey indicated many companies had gone out of business, changed locations or remained unresponsive to the survey.

Of particular significance is a trend toward concentration of boats under the control of the larger companies. Last year, the top 10 boat firms operated 1,221 vessels of all kinds. This year, the top 10 firms (not entirely the same 10 either) operate 1,368.

A common survey response was a change in numbers, either up or down, indicating purchases or sales of boats. While the overall trend in the survey was clearly downward, many companies improved their fleets and grew larger in the last year.

What is surprising to some extent, considering weakened market conditions, is the number of boats under construction. New boats on order for petroleum uses at shipyards around the world this year number 37, compared to 80 vessels under construction a year ago.

The mix of vessel types is still clearly slanted toward exploration and production needs of the petroleum industry. The largest category is that of tugs with 626 individual vessels counted. □

Support Vessels Under Construction

Company and location Number and type (BP)	Size range (lgth in ft)	Horsepower range	Shipyard and location	Delivery date	Est. Value ($ million)
Australian Offshore Services, Perth, Australia					
2 AHTS/FiFi (110)	226	8400	—	87	—
Companhia Brasileira de Offshore, Rio de Janeiro					
4 Supply (30)	141	382	2400 Itajai, Brazil	Corena/ to 4-87	10-86
Eric Miller & Co. Ltd., Trinidad, West Indies					
2 Crew	50	—	Trinidad	June/Oct. 86	1.0
1 Tug	98	—	Trinidad	Suspended	—
1 Crew/Supply	110	—	Trinidad	Suspended	—
Hornbeck Offshore Operators Inc., Galveston, TX					
1 Research	230	3150	RYSCO/Blountstown, FL	—	—
Johannes Østensjø dy, Haugesund, Norway					
2 Platform supply	234	6000	Liaaen/Ålesund, Norway	3-87, 6-87	9.0
Lafayette Crewboats Inc., Lafayette, LA					
5 Rig tender/tug	60	400	—	—	—
McCall's Boat Rentals Inc., Cameron, LA					
3 Crew/Supply	125-145	2600-3250	Gulf Craft/ Patterson, LA	1986	4.3
Otto Candies Inc., Des Allemands, LA					
1 Tug (150)	140	12000	Halter Marine/ New Orleans	1st Qtr 86	—
Smit International Group, Rotterdam, Netherlands					
4 Coastal harbor tug	—	1800	—	Spring 86	—
2 AHTS	—	5200	—	Late 86	—
2 Ocean tug	—	5400	—	Early 87	—
1 Platform supply	—	5200	—	Spring 87	—
1 SS offshore service	—	—	—	Spring 87	—
Suffolk Marine Ltd., Lowestoft, England					
1 Platform support	200	2100	Richards/ Lowestoft, England	7-31-86	7.0
Sverre Farstad & Co., Ålesund, Norway					
1 AHTS (160)	246	13200	Ulstein Hatloe/ Ulsteinvik, Norway	11-30-86	13.0
Swire Pacific Offshore, Hong Kong					
1 AHTS	—	6000	Japan	July 86	—
Wimpey Marine Ltd., Great Yarmouth, England					
2 —	193	3540	Cochrane's/UK	5-86	—

Total vessels under construction: 37

Top 10 offshore vessel operators

Zapata Gulf Marine, Houston	428
Tidewater, New Orleans	295
Crowley Maritime, Seattle, WA	161
Smit International, Rotterdam	101
Offshore Supply Assn., Bremen, West Germany	84
Offshore Logistics, Lafayette, LA	79
Co-Mar Offshore, Morgan City, LA	63
Lafayette Crewboats, Lafayette, LA	58
Otto Candies, Des Allemands, LA	55
McDermott International, New Orleans	44
Total	**1,368**

1986 survey of boat operators

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
A&A Boats, Golden Meadow, LA	13 —	—	—	
AMC Boats, Golden Meadow, LA	3 Supply	—	—	—
Les Abeilles International, Dunkerque, France	4 Ocean tug	208-219	—	16000-23000
	1 AHT	—	—	8000
	2 Crew/supply	209	—	8000
	5 Cargo barge	295-394	—	—
Active Marine Offshore Services, Alesund, Norway	4 AHTS (95-105)	211	1050-1150	7040-8160
	3 Platform supply	220-265	2200-3250	4200-6120
Algosaibi Diving and Marine, Manama, Bahrain	6 Diving/Utility	150	—	—
	2 Barge	120	—	—
Allied Towing, Venice, LA	8 Crew	35-65	—	165
	25 Tug	77	—	165-1800
American Offshore Inc., Houston	2 Tug	—	125-143	2250-4800
	1 Geophysical	—	175	1800
Amsbach Marine (S) Pte. Ltd., Singapore	4 Tug	51-115	—	—
	1 Utility tug	92	—	—
	1 Warehouse ship	479	—	—
	3 Accom. barge	131-253	—	—
	1 Landing craft	118	—	—
	2 Semisub barge	400	—	—
	5 Barge	120-180	—	—
AquaMarine, Houston	2 4-point mooring	170	750	1700
Arabian Gulf Mech. Services, Safat, Kuwait	6 Tug	92-134	—	—
	4 Mooring	33-69	—	—
	9 Crew	92-110	—	—
	2 Barge	160-164	—	—
Argosy Offshore Ltd., Lafayette, LA	6 Supply	181	950-1000	1860-2400
	14 Utility	116-140	90-460	1200
Atlas Offshore Boat Service Inc., Belle Chasse, LA	11 Supply	90-180	—	1300-4000
Australia Offshore Services, Perth, Australia	15 AHTS (60-87)	144-217	—	4400-7200
	1 Supply	163	—	2600
BP Pet. Dev., London, England	1 Emergency Support	120	—	—
	5 Platform Supply	56-87	—	—
	1 Standby	95	—	—
	7 AHPS	58-75	—	—
Bay-Houston Towing, Houston	11 Tug (12-52)	79-89	138-197	1700-4200
	5 Tug (17-29)	96-106	166-197	1700-2400
Bayou Marine, Houma, LA	1 Supply	85	100	800
Berwick Bay Oil, Morgan City, LA	9 Tug	65-96	100-200	1000-5600
Big E Marine, New Orleans	1 Supply	—	—	—
Blaso Marine Co., New Orleans	1 Supply	120	—	1200
	4 Tug	60-85	—	600-1200
Bludco Barge Towing, Houston	3 Tug	82-125	—	2400-6000

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Bordelon Brothers, Lockport, LA	2 Utility/DS/survey	105	100	900
	2 Survey/DS	105-115	100-110	900-1200
	1 Utility/DS	85	86	800
	1 DS/cargo	115	110	1200
	2 Crew	110	100	1600
	2 Tug	65	100	800-1000
	1 4-point mooring/DS	145	130	1400
Broussard Brothers, Abbeville, LA	11 Tug	—	—	900
	4 Crew	—	—	—
Brodr. Klovning, Haugesund, Norway	3 AHTS (120)	190-227	1300-2450	4050-10800
	1 Supply (75)	193	800	6160
Bruce Boat Rentals Inc., Gibson, LA	26 Crew/supply	100-125	95-99	1575-2400
	5 Supply	167-180	260-273	1800-2700
	2 Utility	100-110	92-98	850-1130
Bud's Boat Rental, Venice, LA	14 Supply	—	—	—
	13 Crew	32-100	—	—
Bugsier, Reederei- und Bergungs AG, Hamburg, West Germany	9 Salvage tug (46-189)	113-287	296-2047	3600-20000
	5 Submersible barge	148-300	1500-12250	—
Bukser og Bjergningsselskapet A/S, Oslo, Norway	14 Multipurpose tug	66-118	61-387	535-4400
C-Craft Marine Inc., Galliano, LA	10 Multipurpose	43-110	28-168	600-5600
C & C Boats Inc., Ventura, CA	3 Utility	100-110	—	1200
	6 Crew/supply	90-100	—	1800
	5 Crew	47-77	—	600-1200
C.G. Doris, Paris	3 Self-propelled barge	66-130	82-730	250-800
	1 Non-propelled barge	210	1660	—
	1 Work (8)	66	125	850
C&G Marine, A&A Boats, Golden Meadow, LA	13 Utility	—	—	—
	13 Supply	—	—	—
Cal Dive International Inc., Lafayette, LA	2 DS	166-198	232-322	1800-4000
Callais & Callais Boat Rental, Cut Off, LA	5 Supply	—	—	—
Cameron Crew Boats Inc., Cameron, LA	24 Crew	50-125	99	600-3450
	7 Utility	65-121	48-83	400-600
Candy Boats Inc., Morgan City, LA	19 Crew/utility	100-125	99	2025-2700
C.A.R.E. Offshore, Paris, France	4 AHTS	56-60 (52)	708	5000
Central Gulf Towing Inc., Harvey, LA	10 Tug	50-70	—	400-1500
Chester, Henry Boats, Morgan City, LA	3 Tug	—	—	—
	12 Crew/utility	—	—	—
Coastal Marine, Morgan City, LA	7 Utility	100-125	—	1500-1800
Colle Towing, Pascagoula, MS	8 Tug	81-111	60-292	600-3600
Co-Mar Offshore Marine Corp., Morgan City, LA	29 Crew	100-105	—	1500
	28 Crew/supply	110-125	—	2000-3000
	6 Supply	160-180	—	1800

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Command Marine, Lafayette, LA	8 Supply	180	300	2000-2700
	2 Crew	101	100	2025
Companhia Brasileira de Offshore, Rio de Janeiro, Brazil	7 AHTS	165-185	690-858	2250-3000
	2 Supply	180	800	2480
	1 Tug/supply	180	800	2480
Crowley Maritime Corp., Seattle, WA	105 Tug	85-136	—	1000-9000
	43 AHT	87-136	—	2000-9000
	3 Supply	—	400-600	2000-5000
	9 Crew	—	—	800-2000
	1 Salvage tug	205	—	2250
P.T. Cumawis, Jakarta, Indonesia	5 Landing craft	118-158	253-500	610-1040
	6 Tug (8-18)	68-86	—	460-1130
	13 Cargo barge	138-180	1100-1500	—
	4 Fuel barge	100-180	400-1500	—
D&B Boat Rentals, New Iberia, LA	4 Utility	65-100	—	600-900
	1 Crew	55	—	800
Dawn Offshore Towing, New Orleans	1 Tug	90	—	3000
Digicon Geophysical Corp., Houston	1 Research	—	—	2700
Dillingham Maritime Services (Foss), Seattle, WA	36 Tug	72-126	—	1200-4000
	1 Supply	182	—	3200
Dixie Carriers, Houston	6 Tug	65-115	—	700-3000 B
Dyvi Inc., Houston	4 Heavy-lift	—	—	—
Edda Supply Ships A/S, Oslo, Norway	4 Platform supply	233-265	2450-2750	4600-4800
	1 AHTS (120)	215	1340	9800
Edison Chouest Offshore Inc., Galliano, LA	1 Maintenance	200	—	2250
	2 Coring	150-180	—	1350-2250
	2 Line Handling	87	—	1200
	10 Utility	110-115	—	910-1200
	1 Survey	145	—	2200
	5 Supply	180-196	—	2250
	8 Geophysical	180-250	—	2200-6140
	2 Multipurpose	196-235	—	4070-12735
Em. Z. Svitzer Ltd., Copenhagen, Denmark	2 AHT (105)	161	748-850	11000
	4 Oceangoing tug (26-40)	95-99	219-299	3200-3700
	4 Standby	99-123	187-250	499
Eric Miller & Co. Ltd., San Fernando, Trinidad	3 Tug	57-60	53-69	600-900
	1 Supply	175	757	3000
	1 Supply/tug	166	316	2000
	5 Supply/crew	125-128	247-256	1200-1860
	1 Work	65	40	800
	10 Crew	44-65	25-40	460-800
	1 Crane barge	100	—	—
Eserman Offshore, Golden Meadow, LA	3 Utility/supply	100-135	76-99	1000-1350
	1 Tug	95	143	2400
Fagan Boat Service, Cut Off, LA	4 AHTS	—	907-1000	1530-2310
	2 Supply	—	—	1500
	1 AH/Supply	—	907	2640
Fausteg Group, San Francisco, CA	8 Ocean tug (50)	93	—	4200
Feronia International Shipping, Paris	15 Crew/utility (17-40)	114-148	200-490	1320-3200
	12 AHTS (45-100)	175-195	785-1470	3600-8000
Flotation Services Inc., New Iberia, LA	3 Utility	110	99	1200
	6 Tug	50-55	50-60	400-800
	1 Jackup barge	56	—	600
Four Point Marine Service, Houston	3 4-point mooring	170	650	1700
G&H Towing Co., Galveston, TX	25 Tug (12-52)	82-118	138-299	1000-3400
Galaxie Marine Service, Patterson, LA	16 Utility	100-120	80-99	700-1200
Galaxy Offshore, Belle Chasse, LA	7 Supply	—	—	—
Gardline Shipping Ltd., Great Yarmouth, England	8 Survey/research	136-201	113-695	530-3300
Genina Marine Service, Patterson, LA	4 Utility	—	—	—
Golden Gulf Offshore, Harahan, LA	5 Supply	180	—	3000
Goliath Transport & Shipping B.V., Rotterdam, Netherlands	10 Tug (50-135)	106-212	419-1513	4800-14000
Gonsoulin Enterprise Houma, LA	11 Crew	—	—	—

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Gray Mackenzie Marine Services, Bahrain	6 Tug	—	—	1500-7200
	5 AHTS	—	—	3000-6000
	16 Supply/utility	—	—	1200-2000
	15 Crew	78-110	—	—
	1 Landing craft	157	550	552
Gulf Boat Marine Services Inc., Cameron, LA	12 Crew/supply	65-110	59-99	1000-2700
	5 Utility	80-130	82-99	800-1800
Gulf Coast Transit Co., Tampa, FL	6 Tug	112-150	—	3600-7000 B
Gulf-International Marine, Houma, LA	1 Supply	150	—	2400
	11 Tug	85-120	—	1500-4200
Gulf Operators, Lockport, LA	3 Utility	85-365	—	—
	1 Crew	110	60	800-1000
	6 Tug (40-100)	60-70	40-50	600-1000
	1 AHS	145	—	—
Guzzetta Offshore Marine Service Inc., Berwick, LA	4 Supply (28-35)	130-190	—	1400-3200
	1 Geophysical (20)	180	—	1800
	1 Survey (28)	180	—	2250
Halliburton Services, Harvey, LA	16 Cement Boats	125-180	—	200-1000
	1 Tug	90	—	3500
Hapag-Lloyd GmbH, Hamburg, West Germany	4 AHTS (83-127)	198-222	1116-1900	8000-12000
	2 AHT (98-105)	161	590-620	8000-11000
Harmco Inc., Port Arthur, TX	12 Crew	—	—	—
	1 Supply	165	—	—
Harvey Gulf Intl., Harvey, LA	11 Tug	—	—	600-4200
High Seas Inc. Belle Chasse, LA	1 Supply	166	—	2000
Hornbeck Offshore Operators Inc., Galveston, TX	11 Supply/research	110-190	92-298	1080-2530
	2 Research	180-230	296	2500-3150
Hughes Drilling Fluids, Houma, LA	1 Supply	150	—	1020
	3 Tug	48-55	—	300-900
InterMarine Inc., Houston	3 Well stimulation	165-186	—	1700-2250
	5 Supply	165-175	—	1700-2250
	3 AH/supply (61-63)	165-176	—	3450-4800
	1 AHT	106	—	2110
International Marine Services, Dubai	4 AHT	67-143	106-723	1130-6000
	1 Tug	44	21	40[illegible]
	1 AHTS	165	462	30[illegible]
	1 Maintenance/supply	130	397	900
	1 Utility/service	102	127	800
International Transport Contractors, Haarlem, Netherlands	7 Salvage tug (110)	181	—	15000
	3 Submersible barge	393	19600	—
	1 Heavy-lift VLSS	729	44300	—
International Underwater Contractors Inc., Houston	1 SWATH multipurpose	160	750	2000
	2 DS	125-143	250-290	1600-2500
J-W Operating Co., Morgan City, LA	5 Utility	100-110	98-99	1000-1200
	4 Crew	65-100	56-99	800-1800
Johannes Ostensjo dy, Haugesund, Norway	1 Standby/rescue	163	600	2450
	2 Platform supply	233	2750	5000
	2 FiFi tug (42)	98	300	3000
Knappton Corp. Portland, Oregon	1 Utility	38	—	174
	1 Tug/utility	76	—	1700
	11 Tug	34-150	—	330-4300
Lafayette Crewboats Inc., Lafayette, LA	51 Crew	32-42	10-17	225-450
	1 Tug	44	25	400
	1 Crew/supply	77	78	1170
	3 Rig tender/tug	60	58	400
	1 Tank barge	110	193	—
	1 Accom. barge	110	—	—
LEAM Transportation Inc., New Iberia, LA	6 Supply	180	299	2250
LEEVAC Marine Transportation, Morgan City, LA	4 Tug (32.5-45)	65-110	324-539	900-3600
	14 Tank barge	174-350	1446-12350	—
Lytal Marine Lockport, LA	12 Utility/Supply	90-115	—	600-1200
Maersk Supply (A.P. Moller), Copenhagen, Denmark	14 AHTS (40-90)	175-200	750-1400	3800-7040
	2 Supply	176	692	2400
	3 Multipurpose (110-160)	216-227	2000-216[illegible]	9000-14400
	6 AHT (100)	149	560	8400
Malayan Towage and Salvage Corp., Manila, Philippines	2 AHTS (34)	196	—	2700
	9 Ocean tug (30-60)	143-203	—	2600-6000
	1 Heavy-lift ro-ro	294	2500	1800
	1 Salvage tender (54)	151	—	1230
	1 Warehouse vessel	498	—	8750

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*		SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Maridive & Oil Services S.A.E., Alexandria, Egypt	11	Tug/supply (19-69)	127-184	100-1077	2850-5600
	8	— (3-12)	47-73	—	284-379
Marine Equity Towing Morgan City, LA	1	Tug	75	—	1800
Maritime (Pte.) Ltd., Singapore	5	AHT (26-31)	—	—	2000-2500
	15	Tug (2 5-25)	—	—	210-2500
	20	Cargo barge	120-240	500-6000	—
	2	Crane barge	150	1350	—
	1	Accom. barge	200	—	—
Marsea Agencies, Houma, LA	16	Tug/Supply	180-185	—	2580
Martin, Jimmie B Cut Off, LA	1	Seismographic	—	—	—
	1	Standby	—	—	—
	1	Dive Support	—	—	—
Martin Offshore Boats, Golden Meadow, LA	2	Supply	95-110	—	900-1800
McCall's Boat, Cameron, LA	22	Crew supply	65-145	—	1100-3250
	9	Utility	55-130	—	600-1200
McDermott International, New Orleans	3	Crew	63-103	—	800-1000 bhp
	10	Tug/supply	38-164	—	480-1800
	31	Tug	57-180	—	800-6140
NL Baroid, Houston	2	Supply	132	—	920
	5	Tug	16-60	—	370-740
Nassau Towing Ltd., Freeport, Bahamas	9	Tug	48-110	—	600-5000
	2	Crew	44-48	—	600
Nat-co, Golden Meadow, LA	4	Supply	—	—	—
	1	Crew	—	—	—
National Marine Services, Abu Dhabi	13	Supply	176	—	2250
	2	AHS	176	—	2250
	2	AHT	130	—	3375
	1	Crew/utility	101	—	1530
	1	Maintenance	181	—	2250
Nekton Co., San Diego, CA	3	Survey	90-173	177-466	1300-2400
NICOR Marine Inc., New Orleans	4	Tug/supply (40)	176	700	3080
	4	Seismic (50-87)	225	1313	3600-7200
	2	Crew	100	97	2025
	24	AHTS	191-214	—	2700-6100
	2	Research (50-87)	217	1313	3600-7200
	2	Line handling	80-92	—	1700-2300
Norsul Offshore, Oslo, Norway	8	Crew	78-103	10-190	960-2660
	7	AHS (22)	178-182	970-1006	2480
	2	Supply	180	1006	2250
North Bank Towing, Morgan City, LA	11	Tug	—	—	—
Oceaneering International, Houston	1	DS	172	466	3640
	6	Work DS	95-142	96-199	500-3600
	1	Barge	240	—	—
	1	Utility	150	—	—
Ocean Marine, Houston	10	AHTS (34-100)	180-220	550-1460	3200-7460
O.D.S. Italia S.p.A., Ravenna, Italy	1	DS/maint. (65)	194	1300	4200
	3	Crew/utility	88	85	4040
Offshore Express, Houma, LA	2	AH/Supply	180	292	3000
	10	Supply	166-187	267-284	2000-3900
	5	Utility	100-115	95-137	1250-1600
	15	Crew	42-102	17-99	250-2025
	2	Tug	—	—	—
Offshore Logistics, Inc., Lafayette, LA	33	Crew	65-100	8-75	400-2800
	14	Supply	150-210	420-1770	1430-3000
	11	Utility	102-125	147-226	1300-2800
	16	Towing/Supply	175-195	—	—
	5	AHTS (70-90)	200-228	947-1422	2000-7200
Offshore Service Ships Inc., Belle Chasse, LA	4	Tug/supply	180-185	—	2500-3280
Offshore Supply Association Ltd., Bremen, West Germany	7	Supply	173	782-826	1900
	46	AHTS (25-125)	172-230	725-1540	1900-9330
	17	Platform supply	184-258	1281-2251	3500-6000
	6	AHT (79-95)	146	509-745	5600-7000
	3	Dive support/maint.	167-224	810-1271	1540-3500
	1	Survey drilling/supply	173	810	1900
	4	Ro-ro landing craft (20)	167	668	1740
Offshore Tanker Service, Santa Barbara, CA	10	Crew/supply	65-180	82-199	680-4200
	2	Oil spill cleanup	130-145	99	1200-1600
Offshore Tugs Inc., Raceland, LA	22	Tug (15-73)	70-150	71-196	1800-6000
OIL (Asia) Pte. Ltd., Singapore	4	Supply (25)	148	514	2100
	12	Standby/utility (10)	100	168	1760
	1	ROV support/survey (30)	127	113	2800
	1	Maintenance (7)	170	373	1250
	1	Warehouse barge	180	1600	—
	1	Work (4)	73	—	730
Oil & Gas Rental Service, Morgan City, LA	11	Supply	—	450-1200	3000-3900
Otis Engineering Dallas, TX	5	Multipurpose	—	—	460-680
Otto Candies Inc., Des Allemands, LA	11	Tug	55-140	—	900-9000
	2	Tug/supply	190-205	—	4300-7500
	15	Supply	170-190	—	3000-4300
	2	Crew	100	—	1800
	25	Deck barge	180-350	985-5167	—
Pacific Towboat & Salvage (Dillingham) Long Beach, CA	11	Tug (18-42)	77-100	56-195	1500-3500
	7	Barge	80-248	—	—
Peder Smedvig A/S, Stavanger, Norway	1	AHTS (92)	194	790	7040
	1	Supply	193	1435	4000
Pelham Marine Inc., Houma, LA	12	Multipurpose	165-180	257-298	3200
Penrod Drilling Co., Dallas, TX	21	Supply	—	700-1000	1500-3000
	5	AHTS	—	—	5750-7200
	1	Supply tug	—	—	3400
Performance Marine Transportation Corp., Morgan City, LA	3	Crew/supply	125	99	2250
	2	Crew	110	87	1800
	2	Utility	115	94	1350
Petrol Marine Co., Houma, LA	2	Crew	100	98	1600
	19	Supply	165-185	198-199	2250-2900
	6	AHTS	225	—	12,280
	2	Utility	120	96	1130
Petromar Corp., Rockport, TX	16	Tug/Supply	185-192	292-299	3000-5000
Petróleo Brasileiro S.A. (Petrobrás), Rio de Janeiro, Brazil	2	Ocean tug	282	1920	12000
Petty Ray Geo., Houston	4	Seismic/survey	—	—	1530
Point Marine Inc., Morgan City, LA	9	AHTS (35-42)	185-191	900-1000	3000-4000
	4	Tug/supply (35-42)	185-191	900-1000	3000-4000
	1	Fi-Fi utility	150	823	2000
R.A.G. Boat Cont. Inc., Cut Off, LA	1	Crew	65	57	1050
Rana S.p.A., Ravenna, Italy	1	Work	79	50	320
	1	— (125)	210	1300	4000
	3	—	89	120	4000
Robin Towing Corp., Harvey, LA	1	AHT (40)	130	197	4200
	3	Crew	65-100	59-95	1060-2200
Sabine Towing & Transportation, Port Arthur, TX	10	Tug (22-50)	90-96	—	2000-4200
	1	Supply	180	1054	2250
Safe Offshore AB, Göteborg, Sweden	7	Accom. semi	—	12800-20900	—
	2	Multipurpose	—	14560-20870	—
Safmarine (South African Marine), Cape Town, South Africa	2	Salvage tug (180)	315	—	26200 I
	5	Utility standby	100	—	800 B
Saipem S.p.A., Milan, Italy	2	Tug	131	411-493	2700-3400
	3	Supply	154-197	392-758	1200-2700
	2	DS	210-265	640-3480	1200-4800
Schouest Marine Service Inc., Harvey, LA	7	Utility	65-100	65-99	600-1200
	2	Cargo	170	286	2250
	2	Push	65	140	1200
	1	Tug	65	80	1200
Seaforth Fednav Inc., Halifax, Canada	5	Arctic AHTS (62-129)	184-225	885-1850	5280-12240
	1	AHTS (92)	220	1263	7600
Seahorse, Morgan City, LA (Sold to Zapata Gulf Marine subject to regulatory approval)	5	Crew	85-100	—	980-1350
	17	Supply	130-166	—	1130-1700
	9	Utility	83-110	—	980-1700
	68	Tug/supply	176-210	—	2220-2760
	2	Multi-service	145	—	1300

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Sea Level International, Lafayette, LA	3 DS	175-200	250-299	1800-3000
Seal Fleet Inc. (Sealcraft Operators), Galveston, TX	15 Geophysical	165-210	—	1530-5200
	5 Supply	166-185	—	2500
Sea Mar Inc., Lafayette, LA	2 AHS (40)	180-185	198-298	3000-3800
	2 Supply (20)	166	298	1800
	2 Crew/supply	110	98	2100
	2 Crew	100	98	1600
	2 Utility	115	98	1200
Seamark Marine Lockport, LA	9 Supply	—	—	—
Seamaster Inc., Freeport, TX	5 Supply	—	—	—
Sea Truck Shipping A/S, Sandnes, Norway	3 Multipurpose	196-265	1420-2520	4240-6120
Service Tugs & Crew Boats, Venice, LA	12 Tug	—	—	—
	20 Crew	—	—	—
Shell Oil Co., New Orleans	1 Geophysical	—	—	1605-2250
Shippen Marine, Houston	1 Crew	—	—	—
Simon Møkster, Stavanger, Norway	4 Standby (25-30)	137-167	363-499	1100-2200
	1 Survey	139	299	1150
	1 AHT (63)	121	499	5500
Sirret Offshore Tow Morgan City, LA	1 Tug	64	—	900
Smit International Group (with worldwide affiliates and joint ventures), Rotterdam, Netherands	45 AHTS	—	—	3000-10000
	2 Ocean salvage/AHT	—	—	6000
	8 Ocean salvage tug	—	—	10000-22000
	14 Voith Schneider tug	—	—	1220-4000
	14 Coastal harbor tug	—	—	1500-3000
	9 Tug	—	—	800-4250
	4 DS/maint	—	—	—
	1 Platform supply	—	—	6000
	2 Multipurpose/utility	—	—	4000
	1 Utility	—	—	1800
	1 Tug/terminal support	—	—	6000
Southern-Gulf Marine Inc., Lafayette, LA	8 Crew	100	—	1530
	4 Utility	70-110	—	460-1200
	1 Supply	166	—	1800
St. Bernard Boat Rentals, Chalmette, LA	6 Crew	—	—	—
Star Fleet Inc., Morgan City, LA	8 Supply	—	—	—
Star Offshore Services Marine Ltd., Aberdeen	5 AHTS (90-150)	195-213	1000-2000	7040-9180
	5 Platform supply	204-223	1800-2200	5000
	1 Pipe carrier	265	2750	4600
	1 DS	143	400	1200
	1 Multipurpose	270	2300	5640
State Boat Corp., Houston	28 Supply	150-204	—	910-3000
	3 Tug/supply (40-70)	190-193	—	3900-5750
	2 AHS (40-70)	190-192	—	3900-5750
Stirling Shipping, Glasgow, Scotland	15 Supply	171-210	—	—
	2 DS	180	—	—
	1 Standby	180	—	—
Stolt-Nielsen Seaway A/S, Oslo, Norway	4 DS (45-60)	266-333	1800-2600	8000-12000
	1 AHTS (55)	208	844	4200
	1 Survey/ROV support	184	500	1155
	1 Pipeline protection	530	20820	20000
Straits Engineers Contract, Singapore	13 Tugs	49-220	—	—
	3 Self prop	141	—	—
	7 Hopper barge	120-122	—	—
	12 Barge	60-219	—	—
	2 Dredger	39-49	—	—
	10 Crane barge	90-147	—	—
Suffolk Marine Ltd., Lowestoft, England	4 AHTS (25-50)	170-200	750-1000	2000-4200
Sverre Farstad & Co., Alesund, Norway	6 AHTS (91-132)	211-223	1000-1300	7040-12240
	3 SPC	223-270	2512-3330	6120-6800
	1 Talbot Jackson	200	1800	4200
Swire Pacific Offshore, Hong Kong	5 AHT/utility	107-117	—	2600-2800
	1 AHT	135	—	3200
	18 AHTS	183-210	—	2800-9000
	4 Well stimulation	189	—	2600
	6 DS/maint	135-189	—	1800-3200
	1 Multipurpose/DS	247	—	4000
	2 Survey	128	—	2200
	6 Supply	180-189	—	2300-2800

COMPANY AND LOCATION	NUMBER AND TYPE OF UNIT (BP)*	SIZE RANGE (lgth in ft)	TONNAGE RANGE (dwt)	HORSE-POWER RANGE
Tidewater Inc., New Orleans	84 Towing/supply	165-219	—	2250-8160
	66 Supply	150-189	—	1430-3400
	2 Utility/supply	120	—	1130
	13 Utility	65-110	—	672-1600
	34 Offshore tug	50-139	—	2400-7000
	18 Inland tug	50-100	—	300-900
	1 Crane vessel	186	—	3600
	17 Line handling	92	—	1675
	17 Crew	40-129	—	330-2550
	29 Inland barge	120-140	—	—
	9 Offshore barge	240	—	—
	2 Research	143	—	1580
	3 Special service	170-186	—	1800-3280
TNT Sealion Ltd. (managers), London	7 Supply	202-220	1149-2000	3520-4200
	2 AH/supply	200	1184	4000
Towage and Salvage Union Ltd., Antwerp, Belgium	7 AHT (45-164)	132-198	—	5000-18000
	3 Tug (55-65)	135-185	—	6000
Tracor Marine, Port Everglades, FL	2 Research/supply	144-158	—	1350-1530
Transportation Resources, Houston	3 Crew	—	—	—
	11 Supply	—	—	—
Transocean, Morgan City, LA	4 Crew/supply	110-125	—	1000-2400
	2 Utility	—	—	—
S. Ugelstads Rederi A/S, Oslo, Norway	1 Supply	265	3230	6040
	2 Tug/supply	211	1050-1175	7040-8160
Ugland Group, Grimstad, Norway	1 AHTS/FiFi	226	—	12800
	1 Accom. barge	318	—	19000
	1 RTV	257	—	2000
	1 DS	273	—	7400
Uksnoy & Co. A/S, Bratvåg, Norway	2 Multipurpose	238-263	1440-1528	1300-2640
Unterweser Reederei GmbH, Bremen, West Germany	2 AHTS (96)	195	1100	8000
	2 Supply	195	1150	3500
	4 AHT (33-51)	102-103	—	2750-4200
	5 FiFi tug (26)	86-100	—	1700
	12 Tug (13-31)	84-100	—	1300-3300
United Marine, Morgan City, LA	3 Supply	166	—	2120
United Tugs Inc., Harvey, LA	4 Tug	60-80	—	900-2400
VAC Marine Service, New Iberia, LA	2 Crew	—	—	—
Western Geophysical Co. of America, Houston	31 Geophysical	—	325-946	600-5700
	1 Supply	—	450-700	456-2650
	1 Research	—	406	1700
	1 Energy Source	—	—	—
Wijsmuller B.V., IJmuiden, Netherlands	4 AHT (33-120)	93-157	193-1165	2400-9350
	8 Semisub heavy-lift	456-591	13310-27720	9000-18400
Wilhelmsen Marine Services A/S, Oslo, Norway	2 DS	255-257	—	—
	1 AHTS	211	—	—
Wilhelmsen Offshore Services, Oslo, Norway	12 AHTS (45-100)	174-236	900-2015	4000-10560
	2 FiFi/contingency	265	2000-2165	4000-4800
	4 DS	250-265	1608-2000	4000-8440
	1 Well stimulation	250	2000	13700
Wimpey Marine Ltd., Great Yarmouth, England	6 AHTS (63-147)	193-227	1374-2085	4680-12720
Vroon B.V., Breskens, Netherlands	1 AHTS	180	—	—
	1 Supply	174	—	—
	2 FiFi supply	193-203	—	—
Zapata Gulf Marine Corp., Houston (Fleet totals 428, including Seahorse vessels)	114 AHTS (25-115)	165-218	—	1700-8000
	58 Supply	150-205	—	1600-4000
	80 Tug (14-120)	70-150	—	1050-7280
	18 Crew/utility	65-118	—	850-2240
	4 Maintenance	200-252	—	3000-4200
	3 DS	140-185	—	1700-4000
	3 Platform supply	211	—	4000
	2 Standby/utility	128	—	2280
	2 Cement supply	194	—	7020
	1 FiFi	160	—	3020
	1 Pipe carrier	252	—	4000
	18 Barge	—	—	—
Managed, but not owned, by Zapata Gulf	6 AHTS (45-135)	185-222	—	4000-11200
	6 Supply	166	—	1700-2200
	10 Tug (40-80)	110-145	—	2000-7200
	3 Crew/utility	110-120	—	1500-2000
	7 Well stimulation	194-210	—	2250-7020

Key to common abbreviations: AHTS-anchorhandling tug/supply; AHS-anchorhandling/supply; AHT-anchorhandling tug; DS-diving support; FiFi-firefighting

Deepwater wells survey

The depressed condition of the worldwide offshore drilling community is exemplified in this year's deepwater well survey that shows very few wildcats planned in the deep waters of the world in 1986.

Only five deepwater wells are under way in the Gulf of Mexico thus far this year, even though plans of exploration calls for a minimum of 34. Most industry observers doubt those will be spudded until next year when oil companies may have a better feel for the business climate. Aside from development projects in Brazil, the international deepwater well count appears just as bleak.

According to the 1986 tally, the deepest water being penetrated thus far in 1986 is Sun's Mississippi Canyon 975 wildcat being drilled in 2,930 ft., followed by Placid's Green Canyon 74 No. 1 well in 2,331 ft. Other deepwater projects under way in the U.S. Gulf include: Sohio on Green Canyon 190 in 1,358 ft waters, McMoRan's Green Canyon 751 in 1,460 ft, Sohio's Grand Banks 146 in 740 ft and Unocal's Viosca Knoll 736 wildcat in 644 ft.

Meanwhile, the survey shows the worldwide deepwater well count decreased slightly last year to 153, or 26 less than the 1984 tally. In the U.S. Gulf, 65 wells were drilled in the deepwater regions in 1985, with 34 being sunk in the 1,000 to 1,999 ft range. The hottest area last year was Green Canyon with 20 wells drilled. U.S. wells represent 43% of the 1985 world total. □

1985

Operator	Well location	Contractor	Spud date	Rig name	Water depth (ft)
Texaco	Canada	Sedco	Apr/85	710	3,783
Esso	Canada	Sedco	Apr/85	709	3,510
Shell	U.S./Viosca Kn.	Sonat	Nov/85	Discoverer Seven Seas	3,112
Exxon	U.S./Miss. Can.	755 Sedco	Jul/85	472	3,096
Petrobras	Brazil/Campos 3-RJS-319A	I/S Dynamic Drilling	Mar/85	Pelerin	3,090
AGIP	Libya	Offshore Europe	Jul/85	DS Petrel	2,900
Chevron	Spain	Neddrill	Apr/85	Neddrill II	2,879
Amoco	U.S./Miss Can. 546	Penrod	July/85	78	2,471
Chevron	Spain	Offshore Europe	Apr/85	DS Petrel	2,470
Shell	U.S./E. Breaks 377	Sonat	Oct/85	Discovere Seven Seas	2,465
Shell	U.S./Viosca Kn. 912	Sonat	Feb/85	Discoverer Seven Seas	2,441
Petrobras	Brazil 3-RJS-333	Odeco	Nov/85	Ben Ocean Lancer	2,417
Petrobras	Brazil 3-RJS-325C	Odeco	Aug/85	Ben Ocean Lancer	2,417
Placid	U.S./Green Can. 166	Penrod	Dec/85	76	2,382
TXP	U.S./Green Can. 75	Penrod	Feb/85	77	2,348
Placid	U.S./Green Can. 74	Penrod	Sep/85	75	2,331
Placid	U.S./Green Can. 31-4	Penrod	Apr/85	76	2,238
Amoco	U.K. 208-17-1	Santa Fe	Apr/85	140	2,309
Petrobras	Brazil/Campos 3-RJS-316	I/S Dynamic Drilling	Jul/85	Pelerin	2,224
Gulf Oil	UK/214/27	Sovereign Oil & Gas	Apr/85	Sovereign Explorer	2,140
Petrobras	Brazil/Campos 3-RJS-335	I/S Dynamic Drilling	Dec/85	Pelerin	2,125
Shell	U.S./Garden B. 378	Sonat	Apr/85	Discoverer 534	2,076
Shell	U.S./Garden B. 379	Sonat	Jun/85	Discoverer 534	2,076
Amoco	U.S./Miss. Cn. 546	Penrod	Jul/85	78	2,071
Petrobras	Brazil/Campos I/S 1-RJS-317	Dynamic Drilling	Sep/85	Pelerin	2,030
Exxon	U.S./E. Breaks 328-1	Sedco	May/85	472	1,997
Shell	U.S./Green Can. 73	Sonat	May/85	Discoverer Seven Seas	1,981
Mobil	U.S./Green Can. 72	Sonat	Nov/85	Discoverer 534	1,946
Conoco	U.S./Green Can. 52	Zapata	May/85	Lexington	1,930
Conoco	U.S./Green Can 184	Zapata	Jun/85	Lexington	1,904
TXP	U.S./Miss Can. 542-1	Penrod	Jun/85	77	1,888
TXP	U.S./Miss Can. 542-2	Penrod	Jul/85	77	1,875
Placid	U.S./E. Breaks 305	Penrod	Jun/85	74	1,875
Eniepsa	Red Sea	KCA	Jun/85	Kingfisher	1,863
Eniepsa	Spain	KCA Drilling	Feb/85	Kingfisher	1,791

Operator	Well location	Contractor	Spud date	Rig name	Water depth (ft)
Sohio	U.S./Ewing B. 1003-1	Diamond M	Apr/85	Eagle	1,775
Elf	U.K.	Global Marine	Feb/85	Glomar Arctic I	1,738
Conoco	U.S./Green Can. 228-1	Zapata	May/85	Concord	1,728
Placid	U.S./Green Can. 29	Penrod	Sep/85	74	1,624
Placid	U.S./Ewing Bn. 1001-2	Penrod	Jun/85	72	1,620
Marathon	U.S./Gren Can. 152	Global	May/85	Glomar Atlantic	1,618
Sirte Oil	Libya NC35A	Saipem	Dec/85	Scar.3	1,600
Placid	U.S./Green Can. 29	Penrod	Feb/85	75	1,589
Sirte Oil	Libya NC35A	Saipem	May/85	Scar. 3	1,568
Placid	U.S./Ewing Bnk. 1001-1	Penrod	Jun/85	72	1,557
Britoil	U.K. 206-1-1	Dyvi	Jun/85	Dyvi Omega	1,553
Amoco	Indonesia	Global	Feb/85	Robert F. Bauer	1,547
Sirte Oil	Libya NC35A	Saipem	Dec/85	Scar.3	1,530
Placid	U.S./Ewing Bnk. 1001	Penrod	Mar/85	72	1,527
Conoco	U.S./Miss Can 442	Zapata	Dec/85	Lexington	1,518
Britil	Ireland 35-19-1	Houlder	Apr/85	High Seas	1,500
Amoco	Liberia	Neddrill	Oct/85	Neddrill I	1,498
Amoco	Liberia	Neddrill	Jan/85	Neddrill I	1,495
Eniepsa	Spain	KCA	Apr/85	Kingfisher	1,469
Eniepsa	Spain	KCA	Apr/85	Kingfisher	1,450
Placid	U.S./Ewing Bnk. 999	Penrod	Mar/85	73	1,462
Placid	U.S./Ewing Bnk. 1004	Penrod	Feb/85	74	1,446
Teikoku Oil	Japan	Japan Drilling	Jun/85	Hakuryu V	1,424
Britoil	UK/208/10-3	Dyvi	Apr/85	Omega	1,400
Unocal	U.S./Miss Can. 455	Zapata	Aug/85	Whittington	1,398
Petrobras	Brazil/Campos 3-RJS-328	Sonat	Sep/85	Interocean Discoverer	1,383
Petrobras	Brazil/Campos 4-RJS-328	Sonat	Sep/85	Interocean Discoverer	1,351
Phillips	U.K. 16-12B	Ben Line	Feb/85	Bendoran	1,335
Sohio	U.S./Vios. Kn. 990	Western	Mar/85	Pacesetter III	1,312
Amoco	Nor.34/2-4	Smedvig Drilling	Mar/85	West Venture	1,300
Petrobras	Brazil 3-RJS-325	Odeco	Jul/85	Ben Ocean Lancer	1,300
Petrobras	Brazil/Campos 4-RJS-314	Sonat	Feb/85	Interocean Discoverer	1,297
Amoco	U.S./Gardn Bk. 359-1	Penrod	May/85	75	1,294
Exxon	U.S./Ewing Bk. 438	Global Marine	Jan/85	Glomar Pacific	1,280
Odeco	U.S./Green Can. 21-2	Odeco	Jan/85	Ocean Prospector	1,270
Sohio	U.S./E. Breaks 165	Odeco	Feb/85	Ben Ocean Lancer	1,270
Sohio	U.S./Viosca Kn. 989	Diamond M	Sep/85	Eagle	1,249
Exxon	U.S./E. Breaks 303-1	Zapata	May/85	Yorktown	1,240
Saga	Norway 34/4-6	SDS Drilling	Dec/85	Vinni	1,230
Shell	U.S./Green Can. 23	Sonat	Feb/85	D534	1,217
Conoco	Nor./Haltenbanken	Golar-Nor Offshore	Feb/85	Nortrym	1,217
Amoco	U.s./E. Breaks 170-1	Diamond M	May/85	Hunter	1,199
Chevron	Spain	Neddrill	Mar/85	Neddrill II	1,185
Conoco	U.S./Calif. P-0320	Diamond M	Feb/85	Falcon	1,155
Texaco	U.S./Green Can. 310	Santa Fe	Aug/85	Blue Water IV	1,136
Charterhouse	Nor. 7120-1-A	Penrod	Aug/85	67	1,115
Shell	U.S./E. Breaks 259	Zapata	May/85	Saratoga	1,109
Norsk Hydro	Norway 6407/7-1	Sonat	Oct/85	Polar Pioneer	1,089
BP	Canada	Bow Valley	Jul/85	Bow Drill I	1,075
Statoil	Nor.6121/4-2	Smedvig	Feb/85	West Vanguard	1,040
Statoil	Nor. 7120-5-1	Smedvig	Apr/85	West Vanguard	1,020
Statoil	Nor.6505/12-2	Ross Drilling	Feb/85	Ross Isle	1,017
Sohio	U.S./E. Brks. 206	Western	Dec/85	Pacesetter III	1,013
Saga	Nor. 34-7-6	Wilhelmsen	Mar/85	Treasure Saga	1,011
Exxon	U.S./Miss Can. 281	Dual Drilling	Jan/85	Dual 40	1,001
Exxon	U.S./Miss Can. 281	Dual Drilling	Feb/85	Dual 25	1,001
Vietsovpetro	USSR	Suddimport	--/85	M. Mirchink	1,000
Statoil	Nor.6506/12-3	Ross Drilling	Mar/85	Ross Isle	991
Statoil	Nor./6506/12-2	Ross Drilling	Feb/85	Ross Isle	991
Hunan	China	Japan Drilling	Oct/85	Hakuryu III	984
OPIC	Malaysia	Atwood	Sep/85	Chancellorsville	984
ONGC	India 4-11-1	ONGC	Jun/85	Sagar Vijay	984
ONGC	India AN-14-1	ONGC	Oct/85	Sagar Prabhat	984
BP	Canada	Bow Valley	Jul/85	Bow Drill I	984
Norsk Hydro	Nor. 30-9-5	Wilhelmsen	Apr/85	Treasure Seeker	984

Operator	Well location	Contractor	Spud date	Rig name	Water depth (ft)
ONGC	India AN-63C-1	ONGC	Dec/85	Sagar Prabhat	984
Norsk Hydro	Nor. 30-9-5	ONGC	Jun/85	Sagar Prabhat	984
Sohio	U.S./E. Breaks 206	Western	Dec/85	Pacesetter III	982
Chevron	Spain	Neddrill	Feb/85	Neddrill II	978
Odeco	U.S./Garden Bk. 268	Odeco	Jul/85	Traveler	975
Statoil	Nor.6506/12-4	Ross Drilling	Mar/85	Dyvi Shipping	938
Placid	U.S./Ewing Bnk. 790	Penrod	Nov/85	72	934
Saga	Nor. 6507/11-3	Wilhelmsen	Jun/85	Treasure Saga	928
Sohio	U.S./Viosca Kn. 862-1	Diamond M	May/85	New Era	925
Sirte Oil	Libya NC35A	Saipem	Mar/85	Scar. 3	922
Sirte Oil	Libya NC35A	Saipem	Dec/85	Scar.3	900
Statoil	Nor. 7121/4	Smedvig	Jan/85	W. Vanguard	900
Statoil	Nor. 7120/5	Smedvig	Apr/85	W. Vanguard	900
Petrobras	Brazil/Campos 7-PU-6DA-RJS	Petrobras	Apr/85	Petrobras XV	886
Diamond Shamrock	U.S./Gren Can. 58	Zapata Jun/85	Neptune	874	
Sohio	U.S./E. Breaks 165	Odeco	Mar/85	Ben Ocean Lancer	871
Amoco	U.S./Miss Can. 400	Western	Jan/85	Alaskan Star	856
Petrobras	Brazil/Campos 3-NA-21-RJS	Sonat	Mar/85	Discoverer 511	843
CPC	Taiwan	Lauritzen	Jan/85	Dan Baron	820
Agip	Ionian Sea	Saipem	Jul/85	Saipen Due	810
ONGC	India R-77-1	Dixilyn-Field	Dec/85	DF-45	800
ONGC	India B-172-1	Dixilyn-Field	Oct/85	DF-45	800
Charterhouse	U.K. 20-8	Ben Line	Feb/85	Benreoch	794
Chevron	Spain	Neddrill	Mar/85	Neddrill II	781
Petrobras	Brazil/Campos 3-RJS-309	Sonat	May/85	Interocean Discoverer	781
Petrobras	Brazil/Campos 3-NA-21B-RJS	Sonat	Dec/85	Interocean Discoverer	779
Saga	Nor. 34-7	Wilhelmsen	Jan/85	Treasure Saga	778
Petrobras	Brazil/Campos 3-NA-21-RJS	Sonat	May/85	Petrobras XIV	771
Petrobras	Brazil/Campos 3-RJS-309	Interocean Drilling	May/85	Interocean Discoverer	764
GUPCO	Egypt	Sonat	Apr/85	Comet	764
Mobil	U.K. 14-20-2	Odeco	Nov/85	Scout	750
Diamond Shamrock	U.S./Garden Bnks. 224-1	Zapata	Feb/85	Neptune	750
Petrobras	Brazil/Campos 7-CO-6D-RJS	Petrobras	Jun/85	Petrobras IX	738
Sun	U.S./Garqen Bnks. 273	Penrod	Dec/85	73	735
Statoil	Nor. 6407/4-1	Ross	Jul/85	Ross Isle	734
Statoil	Nor. 34/10-26	Deep Sea Drilling	Oct/85	Deep Sea Bergen	718
Diamond Shamrock	U.S./Garden Bnks. 224-4	Zapata	May/85	Neptune	714
Arco	U.S./Cal.	Diamond M	May/85	Falcon	712
Texaco	U.S./Green Can. 6	Sante Fe	Feb/85	Blue Water IV	710
Texaco	U.S./Gren Can. 6	Sante Fe	Jun/85	Blue Water IV	710
Marathon	U.K. 209-12-1	Global	May/85	Arctic II	702
Petrobras	Brazil/Campos 7-BO-5-RJS	Sonat	Jan/85	Discoverer 511	693
Tenneco	U.S./Green Can. 135	Sedco	Oct/85	702	680
Conoco	U.S./Garden Bnks. 178	Rowan	Jun/85	Midland	680
Conoco	U.S./Ewing Bk. 872	Zapata	Sep/85	Concord	657
ICG-SOGEPET	Canada	Neddrill	Sep/85	Neddrill II	656
Conoco	U.S./Garden Blks. 178	Penrod	Jan/85	73	650
Conoco	U.S./Green Can. 53	Zapata	Jan/85	Whittington	630
Mobil	Indonesia/ Sangen B-2	Atwood Oceanics	- /85	Mission Viking	625
Diamond Shamrock	U.S./Garden Bnks. 177	Zapata	Oct/85	Neptune	611
Sohio	U.S./Ewing Bk. 788	Forex Neptune	Jan/85	Pentagone 82	611
Shell	Portugal	Dolphin	Jun/85	Dolphin	611
Agip	Sicily	Saipem	Nov/85	Scar. 2	610
Texaco	Yugoslavia/Adriatic	INA-Naftaplin	Mar/85	Zagreg-I	600

Worldwide offshore daily average oil production (000 b/d)

Area/Country	1981	1982	1983	1984	1985
MIDDLE EAST					
Saudi Arabia	3,000.00	2,392.00	2,100.00	2,100.00*	1,505.93
Egypt	570.00	570.00	508.65	712.07	743.06
Dubai	359.00	364.00	323.00	346.90	322.20
Abu Dhabi	555.00	443.40	338.46	340.00*	281.00
Neutral Zone	268.00	158.00	216.00	320.00	266.00
Qatar	192.69	167.49	129.20	202.11	195.99
Iran	350.00	—	—	—	610.55
Sharjah	10.50	6.92	6.94	5.90	5.90
Ras al Khaimah	—	—	—	—	9.11
Total	**5,305.19**	**4,101.81**	**3,622.25**	**4,026.98**	**3,924.73**
LATIN AMERICA/ CARIBBEAN					
Mexico	1,105.96	1,638.63	1,673.83	1,793.35	1,702.95
Venezuela	1,043.58	1,026.12	1,128.24	1,100,00	951.12
Brazil	91.83	176.90	197.17	313.04	375.37
Trinidad/Tobago	154.00	135.16	123.28	137.50	135.68
Chile	—	31.26	29.51	23.0	22.14
Peru	26.00	26.56	25.21	26.0	112.95
Total	**2,421.37**	**3,034.63**	**3,177.24**	**3,425.89**	**3,300.21**
NORTH SEA					
United Kingdom	1,800.00	2,060.00	2,270.94	2,479,20	2,548.59
Norway	509.00	534.26	615.00	725.14	755.88
Denmark	15.00	34.00	43.00	46.70	52.40
Netherlands	—	20.83	—	32.0	23.86
Total	**2,324.00**	**2,628.26**	**2,949.77**	**3,352.04**	**3,380.73**
NORTH AMERICA					
United States	1,064.00	1,110.00	1,258.00	1,216.00	1,250.00
SOUTHEAST ASIA/ FAR EAST					
Indonesia	561.00	535.69	438.45	543.25	483.00
Malaysia	250.00	302.20	383.00	439.42	279.48
India	160.00	257.00	342.33	432.00	614.00
Australia	348.14	368.08	241.07	420.00	474.12
Brunei	126.00	121.01	121.60	116.00	98.79
Philippines	7.80	16.50	14.70	10.55	8.51
Thailand	—	6.03	6.81	8.00	13.41
New Zealand	4.50	8.74	6.70	10.08	11.94
Japan	0.88	0.86	0.99	4.00	.81
China	2.00	2.00	2.00	2.00	2.49
Total	**1,460.32**	**1,616.11**	**1,655.65**	**1,985.30**	**1,986.55**
WEST AFRICA					
Nigeria	455.00	371.44	306.08	385.71	415.88
Gabon	113.44	102.52	130.02	130.00*	112.79
Angola/Cabinda	134.00	87.65	142.45	175.00	170.00
Congo	79.00	86.66	94.85	117.50	114.39
Cameroon	—	103.58	93.40	150.00	133.00
Zaire	19.00	21.49	21.32	26.78	17.63
Ivory Coast	9.80	9.37	21.25	22.00	22.08
Ghana	1.80	1.30	1.20	.750	2.00
Total	**812.04**	**784.01**	**810.57**	**1,007.74**	**987.79**
SOVIET UNION					
USSR	196.00	177.00	175.00	168.00	165.00
MEDITERRANEAN					
Spain	21.79	28.37	57.80	44.80	49.10
Tunisia	34.00	30.53	39.16	35.75	29.66
Greece	—	20.92	23.00	26.10	26.35
Italy	6.04	10.01	22.60	22.90	28.21
Total	**61.83**	**89.83**	**142.56**	**129.55**	**133.32**
TOTAL OFFSHORE	**13,664.61**	**13,541.25**	**13,791.04**	**15,311.50**	**15,128.33**
TOTAL OFFSHORE AND ONSHORE	**55,886.20**	**53,191.00**	**53,259.00**	**54,090.00**	**53,391.00**
% OFFSHORE	**24.45**	**25.46**	**26.69**	**28.30**	**28.00**

* *Estimate*

Producing fields by country

Country/field	Wells	Production (b/d)
Abu Dhabi		
Arzanah, 1973	...	...
Abu Al Bukhoosh, 1969	...	...
El Bunduq, 1964	...	...
Mubarras, 1969	...	...
Umm Shaif, 1958	...	...
Upper Zakum, 1964	...	...
Lower Zakum, 1964	...	...
Total	**471**	**281,000**
Angola		
Takula, 1982	49	84,905
Limba, 1969	14	16,353
Malongo N., 1966	69	15,805
Kungulo, 1976	17	15,296
Malongo W., 1969	35	10,985
Malongo S., 1966	32	9,102
Kambala, 1971	5	8,328
Essungo, 1975	10	7,500
Livuite, 1979	7	1,422
Erva, 1969	1	323
Cuntala, 1978	1	100
Total	**240**	**170,119**
Australia		
Mackerel, 1969	18	106,588
Fortescue, 1978	20	95,784
Halibut, 1967	19	83,215
Kingfish, 1967	42	69,574
Cobia, 1972	13	43,371
W. Kingfish, 1968	19	40,601
Tuna, 1968	25	10,498
Marlin, 1966	4	8,698
Flounder, 1968	6	6,926
Snapper, 1968	18	4,453
Barracouta, 1968	2	4,421
Total	**186**	**474,129**
Brazil		
Pampo, 1977	7	55,060
Namorado, 1975	9	40,210
Linguado, 1981	9	35,610
Enchova, 1976	10	35,560
Cherne, 1982	9	31,740
Garoupa, 1974	14	24,090
Ubarana, 1973	56	16,150
Pirauna, 1982	7	15,170
Bicudo, 1982	5	14,550
Corvina, 1983	4	13,630
Trilha, 1983	4	11,580
Bonito, 1977	10	11,410
Xareu, 1977	22	8,700
Curima, 1978	10	7,470
Guaricema, 1968	13	6,000
Viola, 1981	4	5,890
Badejo, 1981	5	5,150
Dom Joao Mar, 1974	283	5,120
Garoupinha, 1974	3	4,800
Atum, 1983	7	4,430
Sul de Pampo, 1978	4	3,930
Camurium, 1970	22	3,780
Parati, 1982	3	3,310
Caioba, 1969	9	3,010
Anequim,	3	2,930
Espada, 1983	5	1,310
Marimba, 1983	1	1,220
Barge, 1983	1	1,170
Agulha, 1975	2	990
Candeias Mar,	14	760
Dourado, 1970	4	510
Robalo, 1973	3	130
Area 1-PAS-11, 1983	...	...
Total	**562**	**375,370**
Brunei		
Champion, 1970	250	50,621
Ampa SW, 1963	207	20,335
Fairley-Baram, 1973	3	17,910
Fairley, 1969	50	9,933
Total	**510**	**98,799**

Country/field	Wells	Production (b/d)
Cameroon		
Betika, 1972	170	126,165
Moudi, 1979	10	5,780
Moudi D., 1980	...	1,055
Total	**180**	**133,000**
Chile		
Ostion, 1977	...	...
Posesion, 1977	...	...
Spiteful, 1977	...	...
Spiteful Norte, 1978	...	...
Total	**104**	**22,140**
Congo		
Yanga, Congo, 1979	47	29,824
Sendji, Congo, 1973	41	27,681
Emeraude, 1969	113	19,782
Likouala, 1979	28	19,023
Loango, 1972	37	18,085
Total	**266**	**114,395**
Denmark		
Gorm, 1971	...	30,770
Skjold, 1977	...	14,105
Dan, 1971	...	7,530
Total	**...**	**52,405**
Dubai		
Fateh, Dubai, 1966	...	...
S.W. Fateh, Dubai, 1970	...	...
Falah, Dubai, 1972	...	...
Rashid, Dubai, 1973	...	...
Total	**156**	**322,200**
Egypt		
El Morgan, 1965	101	169,121
October, 1978	24	105,892
Belayim, 1961	60	119,340
Ras Budran, 1978	7	83,547
July, 1973	30	74,322
Ramadan, 1974	21	64,268
Hilal (404), 1982	4	33,735
Badri (315), 1981	13	26,516
Shoab Ali, 1978	27	22,743
Sidki (382), 1977	5	9,698
Nessim (336), 1981	3	6,723
Younis (347), 1981	5	6,398
Waly (356), 1982	3	6,199
SG-300, 1976	2	3,338
GH 376, 1981	5	3,242
GS 345/346, 1982	3	2,707
GS 277, 1980	1	2,530
SB 339, 1981	1	754
GS 365, 1980	1	646
SB 305, 1981	1	527
WD 33, 1972	2	216
South Remadan,	1	600
LL 87-2E, 1975	1	...
Total	**321**	**743,062**
Gabon		
Lucina-Marine, 1971	16	12,897
P.G.S. Marine, 1975	...	...
Anguille, 1962	...	...
Anguille NE, 1968	...	...
Anguille NNE, 1971	...	...
Barbier, 1972	...	...
Breme, 1976	...	...
Girelle, 1973	...	...
Gonelle, 1972	...	...
Grondin, 1971	...	...
Mandaros, 1972	...	...
Port Gentil Ocean, 1964	...	...
Torpille, 1968	...	...
Baliste, 1974	...	...
M'Bya Sud, 1969	...	...
Anguille SE, 1962	...	...

Country/field	Wells	Production (b/d)
Ayol Marine, 1979	...	...
Baudroie N., 1980	...	...
Baudroie Marine, 1968	...	...
Total	**346**	**112,798**
Ghana		
Saltpond, 1977	5	2,000
Total	**5**	**2,000**
Greece		
Prinos, 1974	15	26,353
Total	**15**	**26,353**
India		
Bombay High, 1974	...	614,000
Total	**...**	**614,000**
Indonesia		
Ardjuna, 1969	293	160,891
Handil, 1974	164	127,067
Attaka, 1970	69	43,239
Bekapai, 1972	47	19,334
Karmila, 1983	6	17,905
Cinta, 1970	45	14,785
Udang, 1974	27	11,853
Yvonne, 1980	11	11,101
Krisna, 1979	38	10,534
Yakin, 1976	20	9,916
Zelda, 1971	43	8,253
Rama, 1974	68	8,003
Sepinggan, 1973	17	7,319
Nilam, 1976	...	6,742
Farida, 1982	22	5,493
Rajah, 1981	3	4,130
Sundari, 1982	15	4,181
Tamboza, 1984	...	3,580
Arimbi, 1972	12	2,573
Selatan, 1971	15	2,044
Gita, 1972	9	1,246
Kitty, 1973	7	1,116
Melahin, 1972	6	907
Kerindingan, 1972	8	645
Nora, 1973	5	792
Duma, 1982	16	223
Titi, 1982	4	12
Total	**970**	**483,884**
Iran		
Bahregansar, Iran, 1960	...	...
Hendijan, Iran, 1968	...	...
Nowruz, Iran, 1966	...	...
Rakhsh, Iran, 1969	...	...
Rostam, Iran, 1966	...	...
Ardeshir, Iran, 1969	...	...
Cyrus, Iran, 1962	...	...
Darius, Iran, 1961	...	...
Fereidoon, Iran, 1966	...	...
Sassan, Iran, 1965	...	...
Total	**167**	**610,555**
Italy		
Nilde, 1977	2	9,420
Gela, 1965	72	6,710
Sarago Mare, 1979	6	4,500
Santa Maria a Mare, 1974	11	2,900
Rospo Mare, 1975	3	2,500
Cela Mare,	17	1,260
Perla,	8	925
Total	**119**	**28,215**
Ivory Coast		
Espoir, 1980	8	16,488
Belier, 1975	14	5,600
Total	**22**	**22,088**
Japan		
Aga-Oki, 1972	13	817
Total	**13**	**817**
Malaysia		
Erb West, 1972	14	11,418
St. Joseph, 1975	9	10,867
Barton, 1971	4	5,165
Bakau, 1971	3	410
Bekok, 1976	30	...
Paulai, 1973	32	...
Tapis, 1975	106	...
Tembungo, 1971	15	...
Kepong, 1979	10	...

Country/field	Wells	Production (b/d)
Tiong, 1978	42	...
Tinggi, 1980	31	...
Total	**236**	**279,480**
Mexico		
Cantarell, 1976	75	945,417
Abkatun, 1978	35	413,608
Ku, 1979	15	176,403
Pol, 1979	8	124,411
Chuc, 1982	3	25,378
Arenque, 1970	17	6,567
Bagre, 1973	8	4,472
Ixoc, 1984	2	3,100
Atun, 1966	7	1,881
Marsopa, 1974	7	1,176
Isla de Lobos, 1963	9	538
Total	**186**	**1,702,951**
Netherlands		
Hoorn, 1981	6	10,577
Helder, 1980	12	8,743
Helm, 1979	7	4,549
Total	**25**	**23,869**
Neutral Zone		
Khafji, 1961	122	243,000
Hout, 1969	69	23,000
Total	**191**	**266,000**
New Zealand		
Kapuni, 1959	12	...
Maui, 1969	14	...
Total	**26**	**11,945**
Nigeria		
Meren, 1965	60	51,116
Okan, 1964	67	41,230
Enang, 1968	21	25,077
Ubit, 1968	37	24,751
Delta South, 1965	27	23,651
Ivak,	8	22,314
Inim, 1966	9	18,563
North Apoi, 1973	28	18,349
Ekpe, 1966	8	18,088
Malu, 1969	18	17,954
Etim, 1968	9	16,134
Delta, 1965	27	15,986
Asabo, 1966	10	15,207
Funiwa, 1978	19	13,296
Meji, 1965	22	14,713
Akam, 1980	9	11,174
Tapa, 1978	10	10,062
Ekpe-WW, 1977	10	9,644
Utue, 1966	7	8,533
Adua, 1967	5	6,513
Parabe/Eko, 1968	23	6,257
Unam, 1968	9	5,535
Mfem, 1967	3	4,515
Mefa, 1965	5	4,084
W. Isan, 1971	9	3,178
Isobo, 1968	4	2,334
Middleton, 1972	10	2,307
Eku, 1966	6	2,219
Pennington, 1965	11	1,755
Idoho, 1966	2	946
Sengana, 1967	2	395
Isan, 1970	...	...
Total	**495**	**415,880**
Norway		
Statfjord, 1974	35	414,064
Ekofisk, 1968	46	132,841
Eldfisk, 1970	32	62,333
Valhall, 1972	18	62,135
Murchison, 1975	14	37,646
Tor, 1970	13	17,741
West Ekofisk, 1970	10	11,999
Albuskiell, 1972	18	9,380
Cod, 1968	6	3,903
Edda, 1972	7	3,847
Total	**199**	**755,889**
Peru		
Capahuari Sur, 1973	26	18,209
Shiviyacu, 1973	18	14,215
Pena Negra, 1960	243	12,597
Lobitos, 1960	230	10,620
Bartra, 1979	16	9,698
Dorissa, 1978	12	9,577

Country/field	Wells	Production (b/d)
San Jacinto, 1978	18	8,339
Jibarito, 1981	5	6,758
Forestal, 1973	10	5,635
Huayuri Sur, 1977	12	4,543
Litoral, 1955	140	3,998
San Jacinto, 1978	3	3,991
Jibaro, 1974	6	3,497
Providencia, 1967	69	1,278
Total	**808**	**112,955**
Philippines		
Matinloc, Philippines, 1979	5	3,779
Cadlao, Philippines, 1977	1	3,690
South Nido, Philippines, 1977	5	1,047
Total	**11**	**8,516**
Qatar		
Bul Hanine, Qatar, 1970	15	...
Idd El Shargi, Qatar, 1960	31	...
Maydan-Mahzam, Qatar, 1963	24	...
Total	**70**	**195,990**
Ras al Khaimah		
Saleh, Ras al Khaimah,	4	9,117
Total	**4**	**9,117**
Saudi Arabia		
Abu-Safah, 1963	...	...
Berri, 1964	...	...
Manifa, 1957	...	...
Marjan, 1967	...	...
Qatif, 1945	...	...
Safaniyah, 1951	...	...
Zuluf, 1965	...	...
Total	**...**	**1,505,933**
Sharjeh		
Mubarek, 1972	4	5,900
Total	**4**	**5,900**
Spain		
Casablanca, 1975	5	30,400
Dorado, 1975	2	7,960
Castellon B., 1972	3	6,000
Salmonete, 1984	2	3,140
Amposta Marino North,	3	1,500
Angula, 1984	1	106
Total	**16**	**49,106**
Thailand		
Erawan, 1973	87	6,864
Platong, 1976	31	2,711
Satun, 1980	50	2,581
Baanpot, 1980	10	1,262
Total	**178**	**13,418**
Trinidad		
Teak, 1971	52	43,475
Soldado, 1955	314	37,618
Poui, 1974	29	22,971
Samaan, 1971	35	18,040
Cassia, 1973	6	8,915
Galeota, 1963	48	4,199
Brighton, 1908	66	464
Total	**550**	**135,682**
Tunisia		
Ashtart	15	22,490
Tazerka, 1979	4	7,176
Total	**19**	**29,666**
United Kingdom		
Brent, 1971	66	439,843
Forties, 1970	55	414,900
Ninian, 1974	60	213,000
Piper, 1973	24	183,630
Fulmar, 1975	12	129,138
Magnus, 1974	9	124,800
Cormorant N., 1974	11	100,625
Beryl, 1972	39	97,966
Brae, 1975	7	88,490
Claymore, 1974	25	82,812
Statfjord, 1974	41	78,341
Maureen, 1973	14	77,245
Thistle, 1973	32	76,631
Murchison, 1975	14	60,241
Dunlin A, 1973	24	55,450
NW Hutton, 1975	17	50,483
Buchan, 1974	8	39,000
Beatrice A, 1976	31	38,825
Cormorant, 1972	13	36,222
Tartan, 1974	10	27,200
Heather, 1973	26	22,925
Beatrice B,	14	18,824
Highlander, 1976	2	18,300
Duncan, 1980	5	14,700
Montrose, 1969	16	14,014
Hutton, 1973	10	11,300
Argyll, 1971	7	9,400
Auk, 1970	11	9,221
Deveron, 1972	2	6,008
Dunlin, 1973	19	5,360
Innes, 1983	1	3,700
Scapa, 1981	2	...
Total	**627**	**2,548,594**
****United States***		
Alaska		
McArthur River, 1965	51	20,679
Middle Ground Shoal, 1963	40	8,383
Granite Point, 1965	27	8,252
Seal Island, 1983	...	...
Total	**118**	**37,314**
California		
Wilmington*, 1932	2,172	113,123
Hondo, 1969	22	34,953
Huntington Beach, 1920	997	22,734
Beta, 1976	48	17,000
Dos Cuadras, 1969	145	15,325
Long Beach, 1921	454	8,134
Elwood, 1928	7	1,049
Point Arguello, 1981	...	...
Total	**3,845**	**212,318**
Louisiana		
Mississippi Canyon Block 194, 1980	49	54,794
South Pass Block 61, 1968	150	35,701
Eugene Island Block 330, 1930	172	30,013
West Delta Block 30, 1949	168	27,421
Bay Marchand Block 2, 1949	171	19,178
Grand Isle Block 43, 1956	146	16,087
Ship Shoal Block 208, 1962	68	13,698
South Pass Block 24, 1950	390	13,698
South Timbalier Block 21, 1939	71	11,676
Main Pass Block 69, 1948	45	10,985
Grand Isle Block 16, 1948	48	8,389
South Pass Block 62, 1965	68	8,273
Main Pass Block 41, 1957	130	7,904
Main Pass Block 306, 1969	105	7,131
South Pass Block 27, 1954	180	6,989
West Delta Block 73, 1962	64	6,849
Ship Shoal Block 207, 1967	50	5,698
South Pass Block 65, 1969	49	5,364
South Pass Block 65, 1969	49	5,364
South Timbalier Block 135, 1956	49	5,002
Ship Shoal Block 204, 1968	38	4,553
Mississippi Canyon Block 397	...	...
Total	**226**	**304,767**

**Only giant offshore fields are shown. Total U.S. offshore production was estimated at 1,250,000 b/d.*

Venezuela		
Bachaquero, 1930	3776	227,747
Lago, 1959	71	13,886
Lagunillas, 1926	5170	352,887
Lama, 1937	380	104,941
Lamar, 1958	179	65,637
Tia Juana, 1928	3,057	186,022
Total	**12,633**	**951,120**
Zaire		
Mibale, 1973	7	16,950
GCO, 1970	7	660
Mwambe, 1979	2	22
Motoba, 1976	1	6
Total	**17**	**17,638**
GRAND TOTAL	**27,171**	**14,365,610**

Most coastal fields do not separate offshore production from land.

International offshore well count*

Country	1981	1982	1983	1984	1985	1986 (est.)
Abu Dhabi	74	89	110	110	70	50
Angola/Cabinda	21	58	74	44	49	40
Argentina	9	10	9	0	5	2
Australia	26	57	54	78	60	65
Brazil	121	148	181	132	168	175
Brunei	26	55	39	62	60	45
Cameroon	40	68	60	65	57	47
Canada	21	21	30	34	53	32
Chile	63	59	63	68	52	22
China	9	17	30	40	26	32
Colombia	1	2	5	0	0	0
Congo	41	73	65	17	10	4
Denmark	12	22	11	5	4	7
Dubai	13	29	29	33	20	13
Ecuador	1	2	3	0	0	0
Egypt	83	84	133	124	132	120
France	7	4	3	1	2	0
Gabon	45	50	48	32	34	25
Germany (West)	5	9	4	12	8	3
Ghana	3	1	2	2	2	0
Greece	9	11	0	0	0	0
India	37	54	81	105	117	122
Indonesia	204	261	315	263	257	181
Iran	2	5	5	—	—	—
Iraq	0	NA	NA	—	—	—
Ireland	8	3	6	6	5	12
Italy	44	62	51	49	43	36
Ivory Coast	18	26	7	8	6	10
Japan	7	10	7	23	12	8
Kenya	1	0	0	0	0	0
Libya	6	5	6	3	—	—
Malaysia	86	110	108	106	112	85
Malta	0	2	2	1	0	0
Mexico	46	53	24	28	32	16
Morocco	1	1	2	1	0	0
Netherlands	40	65	58	55	78	72
Netherlands Antilles	0	1	0	0	0	0
New Zealand	4	0	2	8	5	2
Nigeria	46	89	47	28	25	14
Norway	39	80	62	78	87	74
Oman	0	2	1	1	—	—
Peru	59	75	66	70	58	42
Philippines	15	11	1	2	0	0
Portugal	1	1	0	0	1	0
Qatar	18	15	8	13	10	8
Saudi Arabia	46	84	82	70	65	48
Sierra Leone	0	1	0	0	0	0
South Africa	15	10	14	11	17	13
South Korea	1	0	0	1	0	0
Spain	19	21	16	15	14	7
Sri Lanka	2	1	1	1	0	0
Sudan	2	1	1	1	0	0
Taiwan	6	2	5	2	7	9
Tanzania	2	4	2	1	0	0
Thailand	26	41	96	79	63	52
Trinidad/Tobago	54	4	42	38	35	27
Tunisia	15	17	12	8	10	8
Turkey	2	0	0	1	0	0
United Kingdom	209	235	223	182	157	161
United States	1,075	1,126	1,343	1,371	1118	975
USSR	87	85	87	90	86	90
Venezuela**	12	17	17	8	7	3
Vietnam	0	0	0	2	0	2
Zaire	4	6	6	5	5	3
TOTALS	**2,889**	**3,494**	**3,758**	**3,696**	**3,244**	**2,762**

** Total includes exploration and development*

*** Based on API informations*

Offshore gas production (MMcfd)

Country	1982	1983	1984	1985
U.S.	12,820.00	12,070.00	12,440.00	12,781.00
UK	3,703.00	3,824.00	5,560.00	5,826.00
Norway	2,500.00	3,093.00	2,976.00	2,910.00
Venezuela	—	—	1,693.00	1,693.00
Netherlands	1,140.00	1,071.00	1,528.05	1,537.72
USSR	1,420.00	1,482.00	1,520.00	1,475.00
Mexico	584.65	895.90	1,002.50	937.00
Brunei	850.00	900.00	900.00	833.00
Indonesia	550.00	657.00	872.00	757.00
Australia	550.00	610.00	638.00	677.00
New Zealand	163.00	177.43	336.00	513.00
Nigeria	500.00	480.00	493.00	487.00
Malaysia	—	—	400.00	486.00
Italy	1,018.00	312.30	408.10	414.70
Thailand	—	—	256.00	346.00
Trinidad	488.30	470.00	350.00	346.00
Abu Dhabi	317.00	464.00	414.00	372.00
Angola	—	251.60	268.00	275.00
India	141.00	170.00	246.00	243.00
Brazil	94.76	193.3	221.00	235.00
Ireland	150.00	220.00	223.10	230.30
Colombia	99.10	34.8	176.00	219.00
Denmark	—	—	90.00	200.00
Egypt	73.00	94.1	116.00	112.00
Qatar	—	85.00	92.150	97.30
Spain	—	—	26.60	26.00
Oman	—	—	52.00	48.00
Japan	27.70	27.00	27.00	26.00
Greece	—	6.20	3.00	7.00
Congo	—	—	3.00	3.00
Ghana	7.40	—	—	—
Gabon	NA	7.80	.13	.30
TOTALS	**28,292.30**	**28,383.90**	**33,324.63**	**34,113.32**

ROVs intervene in Gulf, Brazil

Successful BOP recoveries result of advanced ROV handling

Two BOP stack recovery operations that took place earlier this year illustrate how far ROV drill support operations have evolved. The demanding jobs tested both men and equipment to the limit.

Odeco's dynamically-positioned drillship, the Ben Ocean Lancer, dropped its BOP stack, lower marine riser package (LRMP) and 19 joints of riser on February 18 while lowering the gear to drill the 1—RJS—344 wildcat off Brazil. That same month, SubSea International of New Orleans set a depth record when performing a similar recovery in the Gulf of Mexico.

In the Brazilian operation, the riser had separated while being pressure tested during lowering. Even though the water depth at the site was 2,850 ft, a decision was made to recover the 175-ton BOP because its unique control systems would take $9 million and two months to replace.

All hydraulic lines immediately separated and the two multiplex lines spooled off their drums. One was severed at the drum while the other remained attached, but it broke the winch drum away at one bearing.

Hydrospace do Brasil sent its HYSUB 40 ROV down to check out the situation on the bottom. The unmanned vehicle relayed sonar signals quickly to the surface as well as color and black and white video to the two screens in the operator's cabin.

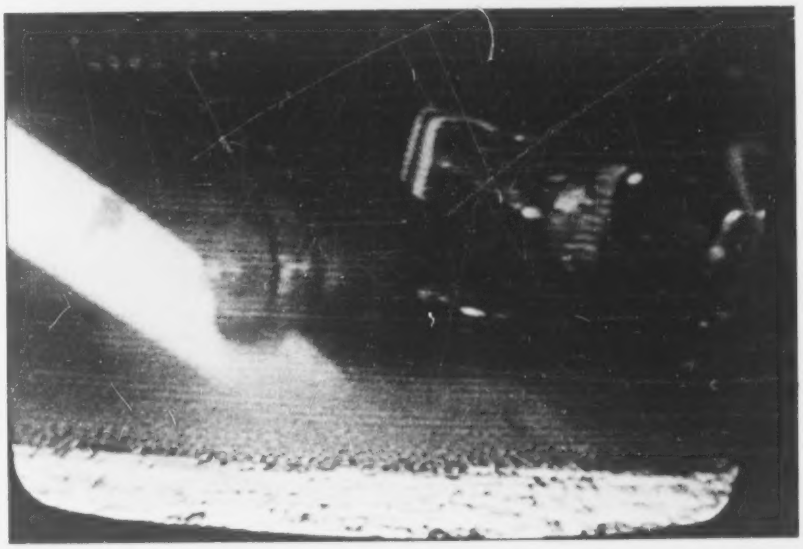
"When we arrived on the bottom the HYSUB's Mesotech 971 color sonar showed the riser lying on the sea bed," says Wayne M. Betts, a Hydrospace supervisor. "We navigated to the riser using the sonar and upon arrival we saw, on the television monitor, a number of hoses and the multiplex cables entangled in and floating up from the riser. This posed a great risk to the HYSUB as potentially we could become trapped in these hoses and cables."

Betts says they carefully maneuvered the HYSUB along the riser toward, "where we hoped the BOP and LMRP lay. As we approached the end we encountered a 5-ft-high wall of mud and bottom debris and on the other side was the LMRP still attached to the riser. The LMRP was upright but buried to within one meter of the top and the riser was bent at 90° at the ball joint."

Following a complete inspection of the riser and LMRP, the survey was continued. The LMRP was found to be 15 meters from the wellhead and there were no large craters in the area, which indicated, the BOP was still attached to the LMRP.

A large 5-ft-high hook was fabricated and hooked by the ROV at the free end of the riser between the choke or kill line and the box or riser pipe connector. The riser was then lifted to a veritcal position. The vessel was then moved around in an effort to break off the riser to reduce lifting weight. The hook snapped first and the riser fell to the seafloor again.

The riser connection with the stack weakened as the pipe cracked and



Hydrospace personnel had to build this cutter on the scene to cut through the riser pipe connected to the drillship's dropped BOP stack.

one of the three lines broke. Another hook was made and the above action was repeated. During this hooking operation, the elevator became entangled in one of the multiplex cables, the rig crew decided to release the cable still attached to the ship. After discussions with the rig personnel, a cable cutter was mounted on the HYSUB and lowered the ROV to the level of the elevator. Four loops of cable were removed from around the elevator with the spacially- correspondent arm and cut the cable jammed in the elevator, which freed it.

The HYSUB was lowered to the bottom and cut the multiplex line still attached to the LMRP, otherwise it would have taken 98,000 lbs pull to break it. A new hook was placed in the free end of the riser. The riser was pulled vertical and with tension applied the ship was moved 360° around the drill string in second attempt to break the choke or kill line and bring the riser to the surface. This failed when the hook broke again.

This time all the riser pipe cracked and one more line broke off, but the hydraulic line held firm. Another attempt to hook it at the joint with the BOP failed because of obstructions. The next phase of the recovery operations called for ramming a spear into the stack's opening. However, this move was obstructed by a piece of metal that had to be milled out with a tungsten carbide bit. After the spear was successfully inserted, an attempt to lift the stack was started. A lifting pipe connection broke when the pulling pressure reached 70,000 lbs. The spear was left sticking out of the BOP at an angle. An overshot tool was used next to latch onto the spear, but it only loosened the spear causing it to drop to the stack's bottom.

There was no other spear in Brazil and one had to be flown in from Houston. The new spear was jammed in and the ship started moving around only this time it also pumped in water through the stack to loosen the mud. The BOP stack broke free of the mud's suction and was lifted to the deck.

Gulf of Mexico recovery

The records set by the above recovery off Brazil did not last long. On February 27, a BOP unlatched from LMRP while being lowered from the Penrod 78 semisubmersible in 2,994 ft of water in the Mississippi Canyon of the U.S. Gulf.

Both BOP stack recoveries show how the diving contractor has advanced in its support of deep water drilling operations.

SubSea International completed this stack recovery in less than five days using a Scorpio ROV system operating six ft of its depth rating. The vehicle was in its standard configuration, free swimming with neither garage or tether management system.

The Scorpio was immediately launched to make an inspection of the area and determined that a number of guide wires were broken and the BOP was buried some 10 ft away from the permanent guide base (PGB) with only a small portion of the bottom face visible.

A decision was made to first recover the PGB. A wire cable was lowered to the seabed from a deck mounted winch and guided into position using Scorpio's sonar. It was attached to the PGB with the use of the ROV's manipulators and guided on its way to the surface. At around 1,600 ft of water it was found necessary to attach an additional cable to the PGB to prevent it from stalling out of the winch. However, both tugger lines became entangled with each other and the rig camera line in 1,578 ft. water and an alternative method was devised to complete the recovery.

A sling was lowered on the rig's drill string and attached by the Scorpio to the PGB, which was still suspended under the rig at 1,578 fsw. Although damaged in the recovery, the PGB was raised to the surface using the combined lifting power of the drill string and two tuggers.

By this time, the oil company had requested the mobilization of a second ROV system as a contingency measure. SubSea mobilized its powerful Pioneer 10 from its facility in New Orleans and had it installed on the rig at very short notice. However, it was not required.

Guide base recovered

By March 2 the PGB had been recovered and a start was made on the raising of the BOP. Two 100-ft slings were rigged from a spreader bar suspended 50 ft below the end of the drillstring. Two large hooks attached to the slings were to be placed by the Scorpio into the inner frame of the BOP, which would then be raised to the surface on the drillstring. In the event the site for attaching the hooks was found to be too tight and the spread was recovered to the surface for modification.

The spreader bar was removed and both slings were attached to a single hook. A tugger line rigged to the back of the hook ran back to the surface to allow more positive control of the hook orientation on the seafloor.

Scorpio guided the hook into position on the BOP using its sonar. Positive location of the hook on the inner frame of the BOP was affected using a combination of the ROV's manipulator, rotation of the drill string and tensioning of the tugger line.

The BOP was pulled clear of the seabed and recovered to the rig with the Scorpio remaining in visual contact all the way to the surface.

Following repair of the PGB it was reset on the wellhead using the Scorpio for gudiance and levelling. The BOP was landed on the guide base on the second attempt, again using the Scorpio for guidance. The ROV stayed on the bottom to observe the latch-up and overpull test. An obstruction on the PGB prevented the latch-up and it was found necessary to recover everything back to the surface for modification.

The PGB was again set on the wellhead overpull test confirmed and bull's-eye angles checked by the ROV. Scorpio subsequently observed the landing and successful latch-up of the BOP, checked all bull's-eye and the condition of the stack and visually monitored the choke and kill tests. The well was back in operation.

Both BOP stack recoveries show how the diving contractor as advanced in its support of deepwater drilling operations. The equipment has become highly sophisticated and the operating personnel are more experienced. □

ROV CONTRACTORS

Model Name	No. in Fleet	No. in Use	Expansions Planned
Bennex A/S, Bergen, Norway			
Sprint 101	2	2	1
Bergen Underwater Services A/S, Ytre Lausevaag, Norway			
Dart	3	2	0
Hysub 60	1	1	0
Hysub 10	1	1	0
Hysub 30	0	0	2
(S/N 48)	1	1	0
Scorpio			
Sea Owl	2	2	1
BUE SubSea, Dyce, Scotland			
Consub 2	1	1	0
IZE	2	2	0
P.I.C	1	1	0
RCV 225	3	1	0
Scorpio	5	5	0
UFO	4	4	0
Cal Dive International, Inc.			
Double-0-Seven (Bandit)	3	2	2
Hysub 40	2	2	1
Mantis ROV	2	2	0
UFO 350	1	1	0
Can-Dive Services Ltd., North Vancouver, Canada			
Haida-1	1	1	0
Haida-2	1	0	0
Mini-Rover	1	1	0
Phantom 500	1	1	0
CanOcean Resources Ltd., New Westminister, Canada			
Scorpio	1	1	0
John E. Chance & Associates, Inc., Lafayette, Louisiana			
Hysub 20	2	2	1 in 1985
Comex Houlder Diving Ltd., Bucksburn, Scotland			
Dart	1	0	0
OSEL Seaworkers	3	3	2
OSEL Template Worker	1	1	0
RCV 225	10	10	0
ROV 400	1	0	0
UFO 300	1	1	0
Commercial Diving Services P/L, NSW, Australia			
Dart I.S.E.	1	0	Probable
Perry P.C. 1804	0	0	Possible
TREC MKII	2	1	Probable
Dominion Diving Ltd., Nova Scotia, Canada			
Scorpio 49	1	1	2 (1985-86)
Viking III	1	1	0

ROV proving worth in cleaning, inspection

The value of remotely operated vehicles in platform nodal cleaning and inspection is being demonstrated by Sonat Subsea Services' recently introduced Challenger vehicle.

According to its developers, the vehicle has been working since February on the first of five structures for Elf Aquitaine Norge in the North Sea. Another Challenger system is also working offshore Australia.

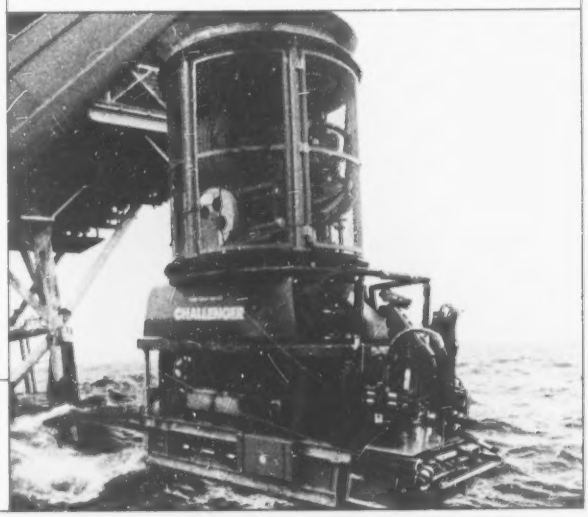
In the North Sea, the unit's tasks include cleaning nodal welds on three steel platforms, cleaning the construction joints on two concrete structures, cleaning fiberglass risers without damaging the coating and intricate cleaning around grouted riser clamps. The Challenger is the first ROV to pass tests for both steel and concrete cleaning and inspection.

The majority of underwater cleaning and inspection concerns controlled cleaning with brushes and high-pressure water jets. For inspection tasks, the vehicle uses special macroimage cameras for ultra-closeups of weld inspection and photogrammetry for still pictures and corrosion pit depth measurement. Inspection systems that will produce sufficient detail so that close analysis of pitting can be made.

"For working in and around subsea structures, the Challenger's high power and relatively small size provide one of the greatest thrust-to-drag ratios of any ROV," says a spokesman for Sonat Subsea. "Up to one-half ton of thrust enables the Challenger to maneuver and maintain station in high currents."

Combinations of two hydraulic manipulators can provide extended reach and unique dexterity with computer-assisted control. The Challenger's IBM minicomputer-based control system coordinates vehicle operating modes, data acquisition and tailored work packages, according to Sonat Subsea.

"Practical access to electronic and hydraulic systems - normally not taken into consideration in other ROV designs - is built into the Challenger," the spokesman said referring to the simplicity of field maintenance for the system. □



The ROV Challenger is shown being deployed from a rig working in the Australian offshore. The Challenger, which has also seen duty in the North Sea, has the greatest thrust-to-drag ratio of any ROV.

Model Name	No. in Fleet	No. in Use	Expansions Planned
Hallstrom Holdings Pte. Ltd., Shenton Nay, Singapore			
Sea Owl	2	2	yes
Hydrospace Marine Services, St. Johns, Newfoundland			
Hysub 20	3	3	0
Hysub 40	2	1	0
Mantis ROV	1	0	0
Sprint 101	0	0	1
Hytec, Montpellier, France			
Hytex Crawler	1	1	3
Intersub Services, La Seyne Sur Mer, France			
Dart	3	3	0
Hysub III	1	1	0
Scorpi	2	2	0
I.S.E. Ltd., Port Moody, Canada			
Arcs	1	1	Yes
Dart	24	24	Yes
Dolphin	2	1	Yes
F.M.V.	1	-	Yes
Hysub 6	1	1	Yes
Hysub 20	21	19	Yes
Hysub 30	2	2	Yes
Hysub 60	3	3	No
Maxi Dart	1	1	Yes
Proes 100	1	1	No
Rasci	7	7	Yes
International Underwater Contractors Inc., City Island, New York			
Mini Rover	1	1	0
Phantom 500	1	1	2
Recon IIIA	1	1	0
Recon 4	2	2	0
ROV Mantis	2	2	2
Super Recon IV	1	1	0
Martech International, Inc., Houston, Texas			
ISE Inspector	2	2	0
ISE Trec	2	0	0
RCV 225	3	3	0
Scorpio	1	1	0
Oceaneering International Inc., Houston, Texas			
Hydra	21	19	0
Hysub	1	0	0
Insector	3	1	0
Orion	1	1	0
RCV 225	2	2	0
Recon	8	5	0
Scorpio	3	3	0
Trov 4	1	0	0
Ocean Team Services Aps, Esbjerg, Denmark			
Ametek Scorpio	1	1	1
Ametek Scorpi	1	1	0
Ametek Gemini	0	0	1
I.S.E. Rascl	2	2	2
OCEONICS, Aberdeen, Scotland			
RCV 225	7	6	0
Rascl	2	2	1
Scorpi	1	1	0
Scorpio	1	1	1 or 2
Sea Owl	2	1	Yes
Sea Pup III	1	0	0

Model Name	No. in Fleet	No. in Use	Expansions Planned
Sonat Subsea Services Inc., Houston, Texas			
Challenger	3	3	4
Mini Rover	4	3	0
Recon IV-S	4	4	0
RCV 150	4	4	0
RCV 225	4	4	0
Scorpio	2	2	0
Trojan	2	2	0
Stolt-Nielsen Seaway Submersibles, Oslo, Norway			
RCV 225	2	3 (1 rented)	0
Scorpio	11	11	2
Sea Hawk	1		3
Sea Owl	1	1	0
Solo	1	1	0
Submersible Television Surveys Ltd., Aberdeen, Scotland			
Rigworker 1800	2	2	0
UFO 300	4	4	0
Sub Sea Dolphin A/S, Tananger, Norway			
Mantis (007 & 008)	2	2	0
Pioneer (13 & 16)	2	2	0
Scorpio (18 & 33)	2	2	0
Sub Sea International, New Orleans, Louisiana			
Hysub	1	1	
Pioneer	18	18	
RCV 225	4	4	
Scorpio	19	19	
Scorpi	5	5	
Viking	3	3	
Taylor Diving & Salvage Co. Inc., Belle Chasse, Louisiana			
Hysub Type 60	0	0	1
RCV 225	4	4	No
RCV 150	1	1	No
Recon 4T	1	1	Yes
Scorpio	2	2	Yes
Uvitek A/S, Tromso, Norway			
Hytec	1	1	3
RCV 225	1	1	0
Scorpi	1	1	0
Sea Owl	1	1	0
Wharton Williams Taylor Group, Dyce, Scotland* (Taylor Diving & Salvage)			
Hysub 20 ROV	4	0	0
Hysub Type 40	1	0	1
Mantis Ads	2	0	0
R3000 Rigworker ROV	4	0	0
RCV 225	9	0	0
Recon IV ROV	1	0	0
Scorpio ROV	3	0	0
Spider Ads	1	0	0
Trident	1	0	0
UFO 350c ROV	2	0	0
Vehicle (TIV)	1	0	0
Wolf Sub-Ocean Ltd., St. Johns, Newfoundland			
Mantis Duplus	4	4	0
UFO 300	2	2	2

**Figures reflect Wharton Williams' Jan. 1, 1985 purchase of 24% of Taylor Diving and Salvage. Taylor Diving is responsible for U.S. operations, Wharton Williams, U.K. North Sea and Wharton Williams Taylor, Middle East, Africa and Southeast Asia.*

ROV Manufacturers

Model/ Rated WD (ft)	Deployment Cage	Standard Features	Normal Duties	Manipulator Type	Max. Load (lb)
Ametek, El Cajon, California					
Super Scorpio 3,000 5,000 (Optional)	Optional Bottom Entry 500-ft Tether	CTFM Sonar LLL TV TV Monitor Auto Heading Auto Depth	Drill Support Inspection	5 Function 7 Function (Optional)	330
Scorpio 3,000	Optional: Side Entry 500-ft Tether	LLL TV Auto Depth Auto Heading Auto Pitch and Roll	Inspection NDT Light Work	Optional: 4-Function	50
Gemini 5,000 10,000 (Optional)	Optional: Tether Management System (TMS) Bottom Entry 500-ft Tether	CTFM Sonar Auto Depth Auto Heading 128 Channel Multiplexer	Drill Support, Cable Burial Heavy Work	As Specified	600
ASD/620 3,000	Full Cage or Bottom Interface TMS Both Optional	Status Display Auto Depth Auto Heading Auto Pitch	Inspection NDT Intermediate Work	5-Function (Optional)	80
ASEA Oil and Gas, Vasteras, Sweden					
Bandit 3000	Guideframe (variable geometry)	Overview camera Reference point camera Wrist cameras Multiplexed Vedeo Tactile sensors	Drilling support Bottom survey	Two 7-function Sensory Manipulators	2,000
Benthos Inc., North Falmouth, Mass.					
RPV-430 2,000	Protective Cage Coupled or Brushless thrusters 3 Translations, 1 Rotational Axis	B&W video & still cameras	Inspection Survey Light Work	3-function electric	26
RPV-2000 Ocean Robot 2,000	Bottom Entry 500-ft Tether	Color, B&W Video Camera CP Probe Brushless thrusters 3 Translations, 1 Rotational Axis	Inspection and Survey Light Work	3-function electric	20
CSI, Paris, France					
PAP 104 300	NA	MARK IV-HIgh definition sonar or TV MARK V-B&W color tiltable TV cameras pressure sensors auto pilot high definition or relocation sonar	Mine Neutralization	MARK V- manipulator turret with assoc. TV camera	
SAR 6,000		High resolution side scan sonar side bottom profiler	Deep sea survey		
EPAULARD 6,000	NA	Still camera recorder safety sensors acoustically linked TV camera in development	Tetherless completely autonomous vehicle for photographic & bathymetric survey		40 kgs.
POPE 150 300 (Optional)	NA	TV camera with pan & tilt 2 projectors	Underwater search, location of devices and material	Arm for manipulating material (optional)	70 kgs.
SEA PLOUGH 900	NA	Ploughshare 3 TV observation cameras obstacle avoidance sonar (400m range) microphone	Burying of Intercontinental telephone cable position surveying	NA	NA
ROV-400 1,640	Not Available	NA	NA	NA	132
Deep Ocean Technology, Inc., San Leandro, California					
Bandit 2,000 & 3,000	Guideline Guidehome (var. geometry)	Overview Camera and 2 Wrist Cams Multiplexed Surface Video Direct Tacticle and Force Feedback	Drilling Support	Hawkes Modular with sensory feedback 4-Function Gripping Hands Sensory Feedback of Touch, Texture, Force.	1,500
ECA, Meudon, France					
Epaulard 20,000	None	Accoustical Remote Control	Photo Survey	None	90
Pope Mark I (400) Mark II (985)	Yes	TV Camera 4 Thrusters	Inspection NDT	Optional	155

Model/ Rated WD (ft)	Deployment Cage	Standard Features	Normal Duties	Manipulator Type	Max. Load (lb)
Gaymarine SRL, Milan, Italy					
Flippo 1,300	Yes	TV & Still Cameras	Inspection NDT	None	7
Pluto 1,150	Optional	TV & Still Cameras	Inspection NDT	6-Function	71
Hydro Products, Inc., San Diego, California					
RCV-225 1,350	Side Entry Cage	Video Annotated With Auto Depth and Heading Control Tether Cable Payout Low-Light TV	Inspection	None	NA
International Submarine Engineering Ltd, Port Moody, B.C., Canada					
Type 6 3,000	Yes	Auto Depth Auto Heading SIT Camera	Observation Light Work	3-Function	15
Inspector 1,200	Optional	B&W Camera Wesmar Compass Var. Intensity Light	Inspection Observation Light Work Pipeline	3-Function	
F.M.V. (Field Maintenance Vehicle)	Yes	SIT Camera B&W and Color Camera	Drillship Support Inspection Cleaning	5-Function	250
Dolphin	None	120 hp Diesel	Survey	None	
Dart 1,200 or 3,000	Yes	B&W Camera Mag. Compass Stick Control	Inspection	None	NA
Hysub 3,000 or Deeper	TMS	2 Bow Cameras 1 Stern Cam Stick Control	Heavy Duty Work Vehicle	5-Function	100-600
Rascl 1,200	Optional	B&W Camera With 60° Tilt	Observation	Optional	20
Hysub 10 3,000	Optional	Low Light TV Var. Intensity Light	Inspection Light Work	3-Function	20
Hysub Series 20 and 40 3,280, 4,920 or 8,200	Yes	Auto Heading Auto Depth Data Display	Drillship Support	5-Function 7-Function	50
ARCS 1,200 3,000 (Optional) (Autonomous Remotely Controlled Submersible)	None	Gyro Compass Depth Sensor	Survey under Arctic Ice	Optional	NA
Trail Blazer 3,000	Optional	SIT Camera Pan & Tilt	Military	4-Function	300-400
Wrangler 1,200 (Tethered or Untethered, Manned or Unmanned)	None	B&W Camera Pinger	Military	4-Function	300
Mitsui Ocean Development & Engineering Co., Tokyo					
MURS-300 984	None	2 TV Cameras 1 CTFM Sonar 4 Thrusters 6 Lights 1 Manipulator	Inspection, Observation	Unilateral Master-Slave	
MURS-300MKII 984	Optional	Open Frame 1-TV Camera Sit Camera with lens pitching mechanism 1-still camera 4-Thrusters DC brushless motors 2-Lights automatic depth & dir. control telemetry PCM using optical fiber	Inspection	None	88
Myrens Verksted, Oslo, Norway					
Snurre 900	None	Auto Heading Depth Control	Inspection	6-Function	440
NeCOS, Rotterdam, Netherlands					
Portunus 1,800	None	CP Monitor	Inspection	2	NA
Ocean Consult, Lauenburg, West Germany					
Supra 1,380	None	Dry Habitat 2 Cranes	Pipeline Repair	NA	20 tons
Offshore System Engineering Ltd. (OSEL Group), Great Yarmouth, England					
UFO 1,400	Standard	CP Probe SIT Camera	Inspection	3-Function	481
Duplus II 3,300 Unmanned	Optional	2 Cameras Pinger Acoustic comm.	Multi-role ROV	7-Function 6-Function 3-Function	660
Rigworker 3,000	Optional	SIT Camera Auto Heading	Rig Support	6-Function Hydraulic	200
Dragonfly 6,000	Standard	SIT Camera Auto Heading	Multi-role ROV	7-Function Hydraulic	1,000
Hornet 2,300	Optional	Acoustic Comm. Instruments	Mid-water ADS	6-Function	330
Mantis 2,300	None	2 x manipulators Life support system Camera	General work		347

Model/ Rated WD (ft)	Deployment Cage	Standard Features	Normal Duties	Manipulator Type	Max. Load (lb)
MICROV 656	None	6 thrusters 1 SIT camera Lighting	Underwater video inspection	None	22
Rigworker 3000S 3,000	Side entry T.M.S. 150 m neturally buoyant tether	6 x hydraulic thrusters Pan and tilt unit 2 cameras Lighting	NA	NA	NA
Rigworker 3000L	NA	6 x hydraulic thrusters Pan and tilt unit 2 manipulators 2 x cameras Lighting	NA	NA	NA
Rigworker 3000LF	NA	7 hydraulic thrusters Pan and tilt unit 2 x manipulators 2 x cameras	Rig and platform support	2 x 6 function hydraulic	NA
Perry Offshore Inc., Riviera Beach, Florida					
Recon IV 1,500	Bottom Entry TMS	Manipulator Work Camera	Anode Installation Drilling Package Production Dive Support	5-function 7-function	374
Triton 303 3,300 10,000 (Optional)	TMS with Armored Cable or no TMS with Kevlar Cable	Large Menu of of Options	Heavy Duty Work Package Deployment	5-function 7-function	500
Seametrix Inc., Delta, B.C., Canada					
Ocean Rover 1,200 (Remote Controlled Towed Vehicle)	None	SIT Camera Depth Spee	Inspection Observation	None	NA
Slingsby Engineering (UK), England					
Cirrus (Cobra) 1,000	Crane + winch assy MTG base 17,500	NA	NA	NA	NA
IZE 985	None	CTFM Sonar Color TV	Inspection	None	NA
LR5 1,499	A-Frame System	NA	NA	NA	NA
MMIM 1,315	Yes	Auto Heading Auto Depth	Inspection Drill Support	7-Function	330
Observer 1,968	TMS & Launcher	NA	NA	NA	NA
Seabed Crawler 100 (650 option)	NA	NA	NA	NA	500
Sea Dog 900	No	TV & Still Cameras	Cable Insp. Burial	SEL General Purpose	880
Solo 4,920	Optional	CTFM Sonar LLL TV Camera	Surveying Inspection	7-Function	385
Spider 610	Total Int A-Frame	NA	NA	NA	NA
Trojan 1,000	Crane 'A' frame	NA	NA	NA	NA
SubSea Offshore Ltd., Aberdeen, Scotland					
SubSea Pioneer 5,000	Optional Subsea Deployment Cage With TMS	CTFM Sonar LLL Camera Auto Heading Auto Depth	Inspection Observation	5-Function 7-Function	200
Scandinavian Underwater Technology (Sutec), Linkoping, Sweden					
Sea Owl 250 820	Optional	6 Thrusters	Inspection	3-Function	NA
Taylor Diving & Salvage Co. Inc., Belle Chasse, Louisiana					
TIV 125	No	Color Camera 38 U/T Probe	Inspection	NA	NA
Trident 2,000	Yes	Color & SIT Cameras Sonar	Drill Support Platform Maint. Inspec.	5-function 7-function	150
UDI Group Ltd., Bridge of Don, Scotland					
Marine Trenching System 1,000	None	6 TV Cameras 3 Sonars Gyro	Trenching Flowlines up to 16 in.	4-Function with 1-ton lift cap.	6 tons or 10
UMEL, Hampshire, England					
Seapup II 2,000		SIT Camera	Observation Diver Support	Under Development	NA
Seapup III 2,000		SIT Camera on Pan and Tilt	Inspection Development	Under	N
ZF-Herion Systemtechnik GmBH, Friedrichagen, West Germany					
David 001 3,300	Optional	TV & Lights Water Jet	Dive Support Inspection Maintenance Repair Salvage recovery	Docking Claw	NA
David 002 3,300	Optional	Color, B&W cameras, altitude sensors Gyro, tracking pinger, status monitoring sensors	Inspection Maintenance Repair Work	Installation of two manipulators	1,760

WORLDWIDE SURVEY OF OFFSHORE PRODUCTION SYSTEMS

While seismic, exploration and delineation drilling activity have reacted sharply to the downturn in crude and gas prices in mid-1986, operators worldwide are apparently continuing to plan and contract for production.

The number of development and production systems under construction, planned or under study recorded in *Offshore's* annual survey is off 14% (43 systems) from the total in 1985. A total of 244 structures are in some stage of planning or construction, compared with 287 in 1985. The survey is conducted in the fall of each year, when plans are finalized for the following year.

Total figures for the Middle East showed a surprising increase in the number of production systems planned for the future. Lead by activity in the United Arab Emirates, 29 structures are planned for the coming years, compared with only 22 units the previous year.

The Middle East was the only highlight, as reductions in plans were evident in every other area of the world.

The area of most significant setback was the Gulf of Mexico, which accounted for over 50% of the falloff from 1985 figures. Operators in the Gulf of Mexico are planning 59 structures, compared with 82 this time last year.

The next vulnerable area was the North Sea. Operators are planning 53 structures, compared with 65 the previous year.

Other areas where losses occurred were the U.S. West Coast, down from 18 in 1985 to 13 this year, Southeast Asia and Oceania, down from 62 to 59, the Mediterranean, from 7 units to 3 units, and Latin America, from 18 structures to 15. □

Under construction, planned, and under study

*(*All structures are steel unless otherwise indicated)*

U.S. GULF OF MEXICO (59)

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
Amerada Hess				
	Production (4)	NA	6	Design
	Matagorda Island 565		70	Late 86
	Drilling,Prod. (8)	NA	24	Design
	South Timbalier 206		165	Late 86
Amoco				
	Well Protector (4)	NA	1-3	Planning
	Drilling,Prod. (4)	NA	6	Design
	South Timbalier 221		155	NA
Anadarko Petroleum				
	Production (4)	NA	NA	Pending
	Vermillion 78 A		NA	NA
Arco				
	Well Protector (1)	Apex	1	Awaiting permit
	Main Pass 128		95	NA
	Production (4)	Raymond-	6	Awaiting permit
	Main Pass 129	McDermott-Zachry	74	NA

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
Champlin Petroleum				
	Drilling,Prod. (4)	NA	NA	Planning
	Ship Shoal 184-B		65	87
	Drilling,Prod. (4)	NA	4	Planning
	North Padre A-57 58		250	87
	Well Protector	NA	NA	Planning
	Ship Shoal 191		65	87
Chevron				
	Caisson	NA	1	Design
	South Marsh Isle 48		102	Nov. 86
	Quarters (6)	NA	NA	Design
	South Timbalier 151		140	May 87
AA	Satellite (4)	NA	6	Design
	Main Pass 299		210	NA
A	Satellite (4)	NA	4	Design
	Matagorda Island 784		183	NA
Conoco				
	Tension Leg Well	NA	24	Design
	Platform, Green		1,850	89
	Canyon 184			
Corpus Christi Oil & Gas				
	Production	NA	NA	Planned
	Main Pass 98		NA	NA
Diamond Shamrock				
	Production (6)	NA	0	On hold
	Main Pass 31		15	2nd Qtr 87
Exxon				
Alabaster	Drilling,Prod.	NA	NA	Design
	Miss. Canyon 397		NA	NA
	Well Prot./Prod. (4)	McDermott	6	Fabrication
	NA	Morgan City, LA	51	NA
FMP Operating (Freeport-McMoRan)				
CJ	Production (4)	Gulf Island	9	Construction
	Vermilion 226		126	Nov. 86
Kerr-McGee				
	Well Protector (4)	Apex Offshore	3	In progress

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
Mark Producing				
	Drilling/Prod. (8)	McDermott	18	Fabrication
	NA	Morgan City, LA	300	86
	Drilling (4)	Gulf Marine	15	Fabrication
	NA	Ingleside, TX	200	86
	Production (4)	Gulf Marine	0	Fabrication
	NA	Ingleside, TX	200	86
Marathon				
F	Drilling/Prod. (8)	NA	21	Planned
	West Delta 79		105	86
A	Drilling/Prod. (4)	NA	9	Under study
	Vermilion 331		220	87
A	Drilling/Prod. (4)	NA	9	Under study
	Matagorda Island 566		80	87
Mobil (Mocpel)				
	Drilling/Prod.	Gulf Marine	30	Fabrication
	Green Canyon 18	Ingleside, TX	760	Late 86
	Well Protector (4)	NA	NA	Planned
	East Cameron 66	NA	NA	86
	Well Protector (4)	NA	NA	Planned
	West Cameron 49	NA	NA	86
	Well Protector (4)	NA	NA	Planned
	West Cameron 176	NA	NA	86
	Well Protector (4)	NA	NA	Planned
	West Cameron 265	NA	NA	86
	Well Protector (4)	NA	NA	Planned
	Eugene Island 147	NA	NA	86
	Drilling/Prod. (8)	NA	NA	Planned
	Vermilion 271	NA	NA	86
	Production (4)	NA	NA	Planned
	Vermilion 320	NA	NA	86
	Production (4)	NA	NA	Planned
	Main Pass 133	NA	NA	86
18-A	Drilling/Prod. (4)	Gulf Marine	30	Construction
	Green Canyon	Corpus, Christi	760	Dec. 86
	Drilling/Prod. (8)	NA	NA	Planned
	S. Marsh Island 205	NA	NA	87
Odeco Oil & Gas				
	Production (4)	Unknown	0	Design
	NA		40	June 87
H_2S	Production (4)	Unknown	0	Design
	NA		40	March 87
Placid				
	Floating Production	Marathon	NA	Under study
	Green Canyon 29	LeTourneau	1,500	NA
	Semi conversion	Brownsville, TX		
Samedan				
	Production (4)	NA	6	Fabrication
	Eugene Island 248	NA	160	NA
3 Units	Drilling/Prod.(4)	NA	9	Fabrication
	Brazos A-52, A-53	NA	NA	NA
Shell				
Bullwinkle	Drilling/Prod. (4)	Bullwinkle Cont.	60	Fabrication
	Green Canyon 65	Ingleside, TX	1,350	Oct. 88
Boxer	Drilling/Prod.	McDermott	NA	Fabrication
	Green Canyon 19	Morgan City, LA	750	NA
	Drilling/Prod.	NA	NA	Planned
	South Timbalier 295		NA	NA
Standard Oil				
	NA	NA	NA	Design
	Ewing Bank 826		NA	NA
Tenneco				
WC 291	Well Protector	NA	1	Design
	Caisson		49	Dec. 86
B	Well Protector (4)	NA	4	In planning
	NA		105	1987
D	Drilling/Prod. (4)	NA	12	In planning
	NA		66	1987
GA 303	Production (4)	NA	4	Design
	NA		65	March 87
MUA22	Production (4)	NA	4	Design
	NA		235	April 87
Texaco				
A	Facility (8)	Hyundai	NA	Construction
	Angola West Africa	Ulsan, Korea	125	Summer 87
B	Well Protector (4)	Hyundai	12	Construction
	Lombo East	Bouygues, Angola	125	Summer 87
C	Production (3)	Hyundai	NA	Construction
	Lombo East	Bouygues, Angola	125	Summber 87
Tubarao	Well Protector (4)	Hyundai	12	Construction
	Tubarao field	Bouygues, Angola	125	Summer 87
Sueide West	Well Protector (4)	NA	12	Construction
	Sueide West		125	Summer 87
Union Texas				
	Drilling/Prod. (4)	NA	12	On hold
	Eugene Island 371		403	NA
	Caisson	NA	1	Engineering
	Vermilion 171		84	April 87
Welter				
	2 Drilling/Prod.	NA	NA	Planned
	Main Pass 301		225	86

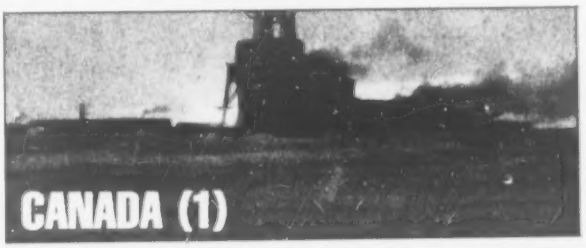
Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation

Arco				
Coal Point	Drilling/Prod. (8)	NA	NA	Design
	Santa Barbara, CA		218	NA
	Drilling (12)	NA	NA	Planned
	Complex Heron		220	NA
	Santa Barbara Chnl			
	Production (12)	NA	0	Planned
	Complex Heron		220	NA
	Santa Barbara Chnl			
	Two Units (8)	NA	NA	Planned
	Complex Hawk		220	NA
	Santa Barbara Chnl			
Cities Service				
Julius	Drilling/Prod. (8)	Hyundai, Korea	70	Fabrication
	San Miguel field		500	Nov. 86
Chevron				
Hermosa	Drilling/Prod. (8)	Hitachi	48	In progress
	Point Arguello field	Ariake	NA	NA
Rocky Point	Drilling/Prod.	NA	NA	Under study
Unit	Off Point Arguello	NA	300	NA
Hacienda	Drilling/Prod.	NA	48	Planned
	Point Arguello field	NA	308	Summer 89
Exxon				
	Drilling/Prod. (8)	NA	60	Design
	Point Pedernales		281	NA
	OCS-P-0438, 0440			
	Drilling/Prod. (8)	NA	60	Design
	Santa Ynez Unit		1,200	NA
	OCS-P-0190			
	Drilling/Prod. (8)	NA	60	Design
	Santa Ynez Unit		1,075	NA
Independence	Drilling/Prod. (8)	Wakamatu	NA	Suspended
	Santa Maria basin	Kita-Kyushu	NA	NA
		Japan		
Shell				
Hercules	Production (8)	NA	NA	Awaiting permit
	Molino field		237	NA
	Santa Barbara			
	Channel			

Amoco				
	Production (6)	Protech	0	Design
	Netherlands P.15	NA	85	86
	Production	NA	12	Under study
	UK 22.18 Arbroath		300	87
K	Sat. Wellhead (4-6)	NA	6	Under study
	UK 49/27 Leman field		130	87
L	Wellhead Prod. (4-6)	NA	12	Under study
	UK 49/27 Leman field		130	87
D	Sat. Wellhead (4-6)	NA	6	Under study
	UK 49/23		100	87
	Indefatigable field		2	Under study
	Single pile/Prod. test	NA	85	Spring 87

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
Arco				
	Production/Qtrs UK Southern basin	NA	0 250	Planned NA
BP				
	Wellhead (4) Southern sector of North Sea	Lewis Offshore	9 150	Construction Spring 87
Britoil				
Amethyst	Prod./Quarters (8) UK 47/14	NA	0 90	Under study NA
Ettrick	Floating Production UK 20/2	NA	NA 360	Under study NA
Conoco				
	Two Units UK Valiant field	NA	NA NA	Planned 86
HGB Ltd.				
DP6	Drilling (4) (12) UK Blk 110/2a	Contract not awarded	14 85	Design Winter 88/89
DP8	Drilling (4) (12) UK Blk 110/2a	Contract not awarded	14 85	Design Winter 88/89
DP5	Drilling (4) (12) UK Blk 110/2a (12)	Contract not awarded	14 85	Design NA
Hamilton Bros.				
	Drilling/Prod. UK Bruce field	NA	NA NA	Under study 90
Maersk (A. P. Moller)				
	Wellhead Danish Roar field	NA	NA NA	Planned 89
	Processing Danish Roar field	NA	NA NA	Planned 89
Marathon				
Brae B	Drilling/Prod. (8) UK 16/7a	Brown & Root- Matthew Hall	34 325	Fabrication Summer 87
North Brae	Drilling/Prod. UK 16/7a	McDermott Ardersier, Scot.	NA NA	Fabrication 88
Mobil				
P/6-C	Production (4) NA	Heerema THC Vlissinger	4 96	Fabrication 87
NAM				
FB	Production Dutch F/3	NA	0 131	Awaiting permits
FE	Wellhead Dutch K/15	NA	24 131	Planned 87
FD	Satellite Dutch K/15	NA	6 98	Planned 88
D	Satellite Dutch L/13	NA	6 98	Planned 88
L	Satellite Dutch Ameland field	NA	NA 26	Planned 89
FB	Satellite Dutch K/8	NA	4 102	Planned 89
FA	Production Dutch L/2	NA	8 118	Planned 90
Norsk Hydro				
Oseberg A	Prod./Qtrs. (4) Norway 30/6 Concrete Gravity	Kvaerner-Aker- Brown & Root- Norwegian Contractors	NA 357	Design June 88
Oseberg B	Drilling Norway 30/6	NA	NA NA	Planned NA
Norske Shell				
Four Units	Drill./Prod./Qtrs. Troll field Norway 31/2, 3, 5, 6 Piled Steel, Condeep (concrete) or T-300	NA NA	NA 900	Under study 92
Pennzoil				
	Production (6) Dutch L/8-9	NA	6 87	Design Mid 87
Phillips				
	Drilling/Prod. UK 16/17, Tiffany- Toni-Thelma fields	NA	NA 430	Under study NA
K	Waterflood (8) Norway Ekofisk 2/4	Aker	NA 230	Fabrication May 87
Audrey	Wellhead UK 49/16-7	NA	6 70	Planned 4th Qtr 87
Placid Oil Int'l				
K12-BP	Living Qtrs/Helideck Dutch Shelf Production (8) Holland Wellhead deck (4) Holland	Heerema Flushing Grootint B.V. Zwijndrecht Grootint B.V. Zwijndrecht	NA NA NA 90 9 90	Construction May 87 NA May 87 NA Feb. 87
Shell Expro (Shell/Esso)				
Eider	Drilling/Prod. (8) UK 211/16a	Highlands Wheesoe Middlesbrough	24 520	Design 88

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
Tern	Drilling/Prod. UK Tern field	RGC Methil	30 550	Design 89
Kittiwake	Drilling/Prod. UK Kittiwake field	NA	16 279	Study 91
Indefatigable N	Unmanned Satellite UK 49/24	THC	4 100	Fabrication 86
Statoil				
Gullfaks B	Prod./Qtrs. Norway 34/10 Concrete/steel (Condeep)	Norwegian Cont. Stavanger Moss Rosenberg Stavanger	20 550	Fabrication August 87
Gullfaks C	Prod./Qtrs. Norway 34/10 Concrete/steel (Condeep)	Stavanger	52 708	Construction May 89
Sleipner A	Integrated Plat. Sleipner field	NA	25 350	Planned Summer 92
Zeepipe Riser	Riser on Pipeline NA	NA	NA NA	Planned 92-93
Total				
NAB	Processing (32) UK North Alwyn field	RGC Methil, Scotland	0 444	Fabrication 86



Mobil				
Hibernia	Drilling/Prod. Off East Coast Concrete base, steel deck	Unknown, Argentia and Adam's Head, Canada	NA NA	Design 91

AGIP-Recherches				
ZAD-1	Production (4) Zatchi Ha. Rine	To be decided	18 200	Under final decision August 87
Elf Angola				
PAL P2	Production (8) Off Angola	Bresilia	NA NA	NA March 87
Elf Congo				
TAT	Flare (4) Gulf Guinea	Pointe, Noire	NA 260	NA Dec. 86
TAF 2	Drilling (4) Gulf Guinea	Pointe, Noire	NA 260	NA Dec. 86
TAF 3	Drilling (4) Gulf Guinea	Pointe, Noire	NA 260	NA Jan. 87
Elf Gabon				
AGMP	Production (4) Off Gabon	Nitchenge	NA NA	NA Dec. 86
Mobil				
EDOP	Production (4) Nigeria OML 67	To be named	4 110	Bidding Mid 87
Texaco				
	Production (8) Lombo East field, Angola	Hyundai Ulsa, Korea	12 123	Construction June 1987
	Well Protector (4) Lombo East field, Block 2 off Angola	NA	12 128	Fabrication 4th Qtr 86

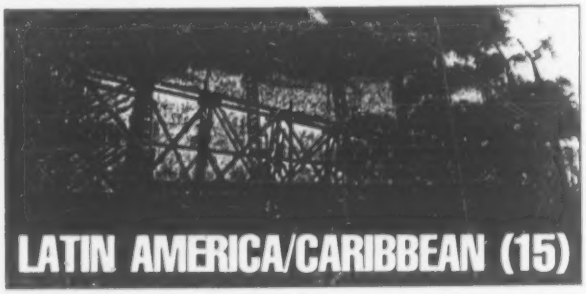
Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
	Tripod Flare	NA	0	Fabrication
	Lombo East field, Block 2 off Angola		123	4th Qtr 86
	Well Protector (4)	Hyundai	12	Construction
	Tubarao field Angola	& Petromar	126	June 87
	Well Platform (4)	Petromar	12	Construction
	Suleie West Angola	Ambrif, Angola	110	June 87

AGIP Name				
DP3	Drilling/Prod. (20)	NA	24	Planned
	Bouri field off Libya		558	Mid 87
	NA	NA	NA	Fabricating
	Bouri field off Libya		166	NA
Hispanoil				
	Floating Prod.	NA	NA	Planned
	Salmonte field		NA	86
	Ebro Delta off Spain			
Montedison				
Vega A	Drilling/Prod. (8)	Consorzio	30	Fabrication
	Sicily Channel	Italoffshore Punta Cugno	402	Fall 86

Arco Indonesia				
XMA	Well (4)	P.T. Adiguna	9	Design
	Ardjuna field	Indonesia/ P.T. McDermott	90	Dec. 86
ZUA	Well (4)	P.T. McDermott	19	Fabrication
	Bima field	Indonesia/ P.T.Gunanusasia	9	Dec. 86
ZUB	Well (4)	P.T. McDermott	9	Fabrication
	Bima field	Indonesia/ P.T.Gunanusa	97	Dec.86
ZUC	Well (4)	P.T. McDermott	9	Fabrication
	Bima field	Indonesia/ P.T. Gunanusa	97	Dec. 86
ZUD	Well (4)	P.T. McDermott	9	Fabrication
	Bima field	Indonesia/ P.T. Gunansua	96	Dec. 86
ZU Junction	Processing (4)	NA	0	Bidding
	Bima field		91	Dec. 86
ZUE	Well (4)	P.T. McDermott	9	Design
	Bima field	Indonesia	91	Dec. 86
ZUF	Well (4)	P.T. McDermott	9	Design
	Bima field	Indonesia	91	Dec. 86
ZUG	Well (4)	P.T. McDermott	9	Design
	Bima field	Indonesia	91	Dec. 86
ZU QTRS	Quarters (4)	NA	9	Bidding
	Bima field		91	April 87
Bohai Bay Oil				
	Production	NA	0	Planned
	Bohai Bay, China		61	NA
Bond				
	Satellite	NA	NA	Planned

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
	Heera field extension WA192P permit off Australia		NA	NA
Carigali/Petronas				
Dulang A	Drilling (4)	NA	24	Design
	South China Sea West Malaysia		249	NA
Dulang B	Production (8)	NA	24	Design
	South China Sea West Malaysia		249	NA
Dulang C	Drilling (4)	NA	24	Design
	South China Sea West Malaysia		249	NA
Dulang D	Drilling (4)	NA	28	Design
	South China Sea West Malaysia		249	NA
Chengbai Oil				
A	Drilling/Prod. (16)	Bohai Oil	24	Planned
	Bohai Gulf, China	Copec	50	86
BZ-32	Drilling/Prod. (4)	Nippon Steel	24	Planned
	Bohai Gulf, China	Japan	67	NA
Esso Australia				
	Production (4)	Barry Beach	27	Fabrication
	Bream field		195	1st Qtr 87
	Production (8)(4)(8)	Barry Beach	27	Construction
	Bream, Bass Strait		195	Oct. 87
B	Production (4)	Barry Beach	50	Planned
	Tuna field		195	1st Qtr 88
Esso Production Malaysia/Petronas				
Guntong B	Production (4)	NA	32	Design
	South China Sea		207	NA
Guntong C	Production (4)	NA	32	Design
	South China Sea		207	NA
Hudbay				
	Two Wellhead	NA	NA	Planned
	Mengkapan field off Indonesia		NA	NA
Japex Offshore				
	Drilling/Prod.	NA	20	Design
	Iwafune-Oki, Sea of Japan		115	Aug. 87
	Drilling/Prod. (8)	NA	20	Planned
	Iwafune-oki, Japan		115	Aug. 88
JCODC (Japan China Oil Development Co.)				
BZ28-1	Two Satellite	NA	NA	Engineering
	Bohai Gulf off China		NA	NA
BZ28-1	Floating Prod.	NA	NA	Planned
	Bohai Gulf off China		65	87
BZ34-2/4	Floating Prod.	NA	NA	Under Study
	Bohai Gulf off China		65	88
ONGC				
	Drilling	Hyundai	NA	Fabrication
	South Bassein field	Ulsan, Korea	NA	86
	Processing	Hyundai	0	Fabrication
	South Bassein field	Ulsan, Korea	NA	86
	Quarters	Hyundai	0	Fabrication
	South Bassein field	Ulsan, Korea	NA	86
	Flare Structure	Hyundai	0	Fabrication
	South Bassein field	Ulsan, Korea	NA	86
	Jackup (3)	Hitachi Zosen	0	Construction
	Panna field	Osaka works, Japan	300	Dec. 86
IF, IG, IH	Production (4)	S. Korea Samsung	9	Fabrication
	Bombay High South field		249	Sept. 87 & Oct. 15, 1987
HD	Wellhead (4)	Wakamatu	9	Construction
	Bombay	Kita-Kyushu	187	Feb. 87
HE	Wellhead (4)	Wakamatu	9	Construction
	Bombay	Kita-Kyushu	169	Feb. 87
POC				
	Production	NA	8	Planned
	3DA structure, Gulf of Martaban off Burma		NA	NA
SSB/Petronas				
D18	Drilling	Promet	8	Fabrication
	South China Sea East Malaysia	Johore, Malaysia Sime Sembawang Johore	110	NA
F6DP-A	Drilling (8)	Hyundai	20	Fabrication
	South China Sea East Malaysia	Korea	284	NA
F6P-A	Production (8)	Promet	10	Fabrication
	South China Sea East Malaysia	Johore, Malaysia Hyundai, Korea	284	NA
F6Q-A	Quarters (4)	Hyundai, Korea	0	Fabrication
	South China Sea East Malaysia	Sabah Shipyards Sabah, Malaysia	284	NA
F6V-A	Vent (3)	Promet	0	Fabrication
	South China Sea East Malaysia	Johore, Malaysia	284	NA
Barton-B	Drilling (4)	NA	6	Design
	South China Sea East Malaysia		126	NA

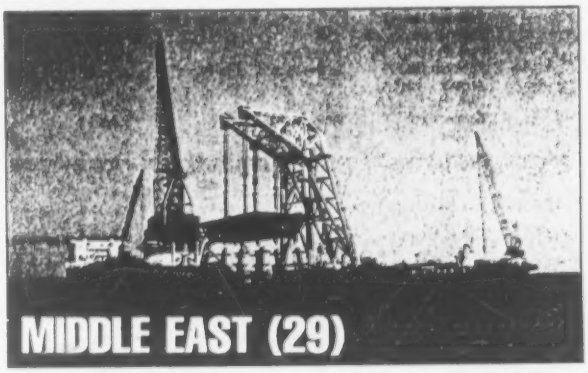
Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation
SSPC/Petronas				
St. Joseph	Drilling (4) South China Sea East Malaysia	Promet Johore, Malaysia	6 125	Fabrication NA
Sakhalin Oil Development				
	Drilling/Prod/Qtrs (4) Chaivo field	NA	NA 100	Under study Middle 90s
Shell BP/Todd				
	Production Maui field off New Zealand	NA	NA NA	Planned NA
Sumatra Gulf				
	Prod./Well Prot. (4) Anoa field off Indonesia	NA	18 270	Planned 86
Total Indonesia				
Handil	Production	P.T. Komantini Indonesia	NA 10	Fabrication 86
Total China				
	Drilling/Prod. Weizhou field off China	CBODC, China Nippon Steel Japan	NA NA	Fabrication NA
Unocal Thailand				
PWF	Wellhead (4) Gulf of Siam	Wakamatu Kita-Kyushu Japan	12 213	Construction NA
PWG	Wellhead (4) Gulf of Siam	Wakamatu Kita-Kyushu	12 213	Construction NA
PWH	Wellhead (4) Gulf of Siam	Wakamatu Kita-Kyushu	12 213	Construction NA
Vietsovpetro				
	Two Drilling White Tiger field off Vietnam	Baku, USSR	16 NA	Fabrication NA
	Service/Supply White Tiger field	NA	NA NA	Planned NA
Woodside Offshore				
Goodwyn	Under review	NA	24 420	Planned 91



LATIN AMERICA/CARIBBEAN (15)

Belco (Petromar)				
PN-8	Drilling/Prod. (4) Pena Negra field	Belco Talara, Peru	12 371	In Progress Dec. 86
Petrobras				
Pargo 1A	Production (4) NE Campos Basin	Tenenge Paranagua, Braz.	21 331	Design July 87
PCM-9	Prod./Drilling (8) Camonm field	CEC/Odebrecht Rio, Salvador	15 80	Construction Apr. 87
PCM-10	Pro./Drilling (4) Camonm field	NA NA	6 80	Planned Jan. 88
PCM-11	Production (4) Camorim field	NA NA	6 80	Planned Dec. 87
PCA-3	Production (4) Cacao field	FEM Paranagua	6 80	Construction Mar. 87
PAT-3	Production (4) Atum field	A. Araujo/CEC Sergipe, Rio	12 140	Construction Mar. 87
PPG-1A	Production (4) Pargo field	Tenenge Paranagua	21 333	Construction Nov. 87
PPG-1B	Quarters (4) Pargo field	Montreal Salvador	NA 333	Construction Nov. 87
PCP-1	Production (4) Carapeba field	Odebrecht Salvador	15 286	Construction Oct. 87
PCP-2	Production (4) Carapeba field	Mendes Jr. Salvador	21 286	Construction NA
PVM-1	Production (4) NA	Ultratec	21 NA	Construction Feb. 86
Shell				
	Two Drilling/Prod. Strait of Magellan off Argentina	NA	10-11 230	Planned NA
Total				
	Two Drilling/Prod. Hidra field Argentina	NA	9 90	Planned NA

Operator Platform name	Type (no. legs) Field & location	Fabricator Jacket/Deck	Well Slots Water depth(ft)	Status/ Installation



MIDDLE EAST (29)

ADMA-OPCO				
ABK 11	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 43	Fabrication 86
ABK 2	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 44	Fabrication 86
ABK 3	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 40	Fabrication 86
ABK 4	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 28	Fabrication 86
ABK 5	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 32	Fabrication 86
HD 3	Drilling/Prod. (4) Off Abu Dhabi	NPPC Abu Dhabi	6 32	Fabrication 86
Amoco/Gupco				
L-Morgan	Gas Lift (8) Gulf of Suez	NA	0 110	Planned 86
Arabian Oil				
CP-1	Gas Comp. (8)/(40) Khafji oil field	Daewoo Korea	NA 100	Construction 87
RP-2	Gas Pipe Riser (4)/(30) Khafji oil field	Daewoo Korea	NA 100	Construction 87
TIP-4	Gas tie-in (3)/(30) Khafji oil field	Daewoo Korea	NA 100	Construction 87
IP-1	Inter. plat. (3)/(30) Khafji oil field	Daewoo Korea	NA 100	Construction 87
Dubai Petroleum				
	Waterflood SW Fateh field	NA	0 130	Planned 86
Gelsum Oil				
Gelsum B	Drilling/Prod. (4) Gulf of Suez	NA	9 85	Under study Late 86
Gelsum C	Drilling/Prod. (4) Gulf of Suez	NA	9 85	Under study Late 86
KNPC				
	Loading Plat. (16) Mab Sea Island Kuwait	NPCC Sadiyat	NA 67	Construction Jan-Feb 87
Udeco				
	NA Satah Bridge	NPCC Sadiyat	NA NA	NA NA
	NA (4) Satah	NPCC Sadiyat	NA NA	NA NA
PMP	Jacket (6) Satah	NPCC Sadiyat	NA NA	NA NA
2FP	Jacket (4) Satah	NPCC Sadiyat	NA NA	NA NA
2FP	TPWER Satah	NPCC Sadiyat	NA NA	NA NA
WHP1	Production (4) Satah	NPCC Sadiyat	6 45	NA NA
WHP2	Production (4) Satah	NPCC Sadiyat	9 36	NA NA
WHP3	Production (4) Satah	NPCC Sadiyat	6 48	NA NA
WHP4	Water Injection (4) Satah	NPCC Sadiyat	6 31	NA NA
WHP5	Water Injection (4) Satah	NPCC Sadiyat	6 39	NA NA
WHP6	Production (4) Satah	NPCC Sadiyat	9 14	NA NA
WHP7	Prod. Water Injection (4) Satah	NPCC Sadiyat	6 44	NA NA
WHP8	Production (4) Satah	NPCC Sadiyat	9 46	NA NA
WHP9	Gas Prod./Injection (4) Satah	NPCC Sadiyat	6 45	NA NA
PMP	Production (6) Satah	NPCC Sadiyat	NA 44	NA NA

OFFSHORE RIG REPORT

Caribbean rig activity triples

CARIBBEAN WATERS have seen little rig activity for some time, but since last month's report the region's working rig tally has tripled, though the increase is only from one rig to three. One of those represents a return to Bahamian waters after a long absence.

Louisiana was the only area with a big gain in activity, adding 15 working rigs.

The onset of winter idled eight rigs that had been working off Canada. Other major losses were in Southeast Asia (down four), Australia/Oceania, Mafla and Texas (three each).

Offshore's "Top 5 Operators" list had to be expanded to seven for this issue as Arco, Conoco and Exxon/Esso tied for fourth place with 18 operatorships each.

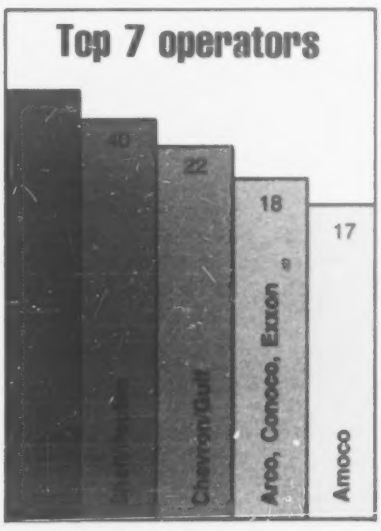
There was more bad news in U.S. marine seismic activity figures for November. The previous month's decline of four vessels was repeated, reports the Society of Exploration Geophysicists. Six oil company and 35 contractor vessels found work for a total of 41. □

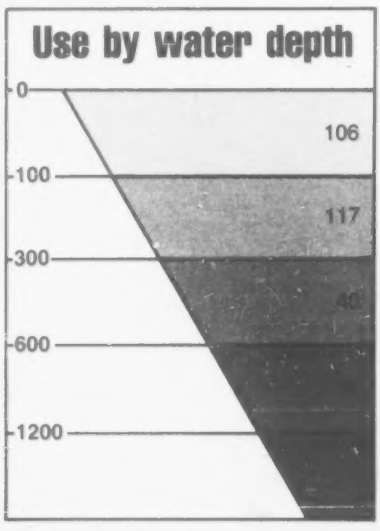
Rig recap

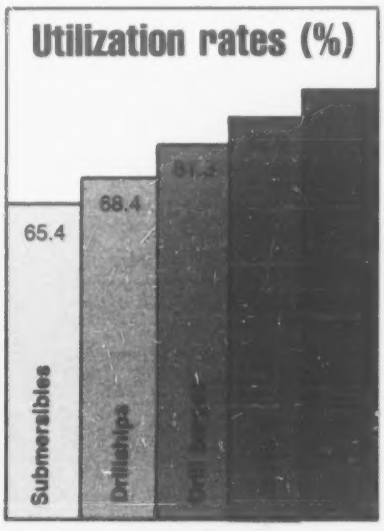
Area	Current Working	Current Idle	Current En Route	One Year Ago Working	One Year Ago Idle	One Year Ago En Route
Africa	25	7	0	24	9	0
East Europe/USSR	23	4	1	19	2	0
Mediterranean	20	12	0	25	5	0
Middle East	56	23	0	59	21	0
North Sea	91	8	4	85	11	4
Western Europe	4	2	1	4	6	0
Australia/Oceania	5	1	1	3	3	1
Japan	2	1	1	2	0	0
Southeast Asia	51	27	2	60	22	2
Canada/Greenland	6	11	1	11	4	0
Caribbean	3	1	0	0	1	0
Mexico/Cent. America	7	2	0	9	2	0
South America	56	18	1	53	13	0
U.S.						
East Coast	0	0	0	0	0	0
Louisiana	138	35	0	156	18	1
Mafla	10	5	0	6	2	0
Texas	42	24	0	51	13	0
West Coast	4	7	0	8	5	2
Total	**543**	**188**	**12**	**575**	**137**	**10**

Units under construction: Drillships 1, jackups 16, semisubmersibles 26, submersibles 0, other 0; total 43.

Source: Electronic Rig Stats, Dec. 6, 1985. Only OCS-rated rigs are surveyed.







Source: Electronic Rig Stats, Dec. 6, 1985. Note: Information on water depth has been furnished to ERS for 297 working rigs.

OFFSHORE RIG REPORT

West Coast down to 2 working rigs

RIG ACTIVITY off the U.S. West Coast is at its lowest point in years. Early in 1985 the region had 10 working and five idle rigs; now the respective numbers are two and nine. The West Coast (down two) and Mediterranean (three) were the only areas to lose more than one working rig from the previous month. Southeast Asia led gainers by adding six working rigs.

After leading the operators list for most of 1985, Petrobras has dropped into second place. The Shell/Pecten group is on top by one operatorship.

The leading countries of registry for the active fleet are: U.S., 345 rigs; Panama, 102; Liberia, 38; Norway, 26; UK and Venezuela, 24 each; USSR, 21; China, 14; Canada, 13; and Brazil, 10. Twenty-six other nations have single-digit tallies.

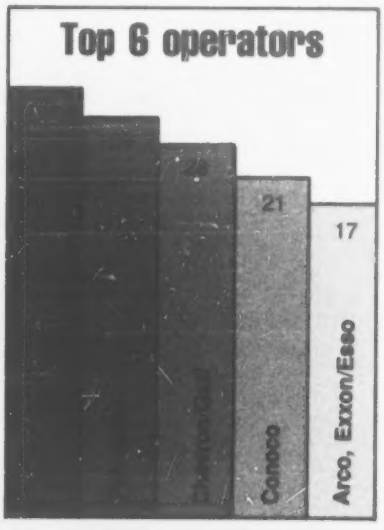
Seismic activity in U.S. waters is still declining, says the Society of Exploration Geophysicists. Six oil company and 30 contractor vessels worked during December—down five from November and 13 below 1985's August-September peak of 49. □

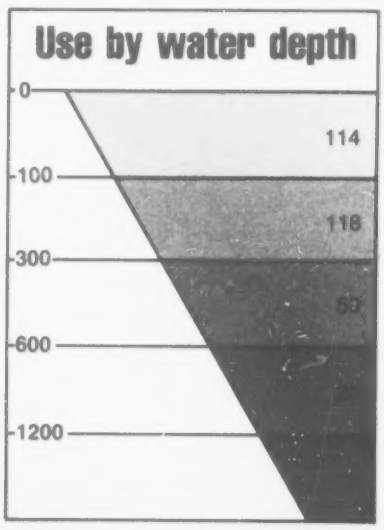
Rig Recap

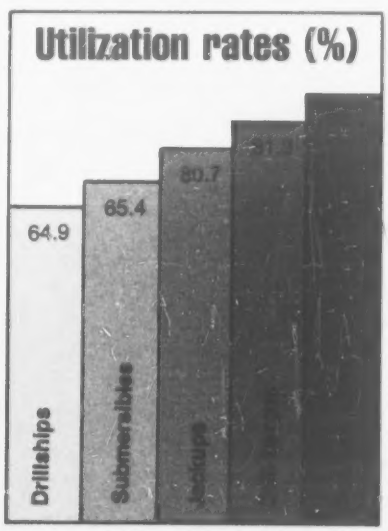
Area	Current Working	Current Idle	Current En Route	One Year Ago Working	One Year Ago Idle	One Year Ago En Route
Africa	24	8	0	24	9	0
East Europe/USSR	22	4	1	19	2	0
Mediterranean	17	12	2	25	5	0
Middle East	56	25	0	59	21	0
North Sea	94	7	2	86	14	1
Western Europe	5	2	0	4	6	0
Australia/Oceania	4	2	1	5	2	0
Japan	1	1	1	2	0	0
Southeast Asia	57	25	1	61	22	1
Canada/Greenland	6	10	2	10	6	0
Caribbean	3	1	0	0	1	0
Mexico/Cent. America	7	2	0	9	2	0
South America	55	20	0	56	11	0
U.S.						
East Coast	0	0	0	0	0	0
Louisiana	141	33	1	157	10	0
Mafia	9	3	0	7	2	0
Texas	44	24	1	60	10	0
West Coast	2	9	0	10	5	0
Total	547	188	12	594	128	2

Units under construction: Drillships 1, jackups 16, semisubmersibles 26, submersibles 0, other 0; total 43.

Source: Electronic Rig Stats, Jan. 6, 1986. Only OCS-rated rigs are surveyed.







Source: Electronic Rig Stats, Jan. 6, 1986. Note: Information on water depth has been furnished to ERS for 321 working rigs.

OFFSHORE RIG REPORT

Jackup rig demand falling

JACKUP DEMAND continues to slacken, which greatly affects utilization figure in Gulf of Mexico. Reports of slot-type jackups going for less than $10,000/day are not uncommon. One Houston-based contractor is reportedly offering a slot jackup for $7,500. Number of working U.S. Gulf rigs dropped from 141 last month to a March total of 125.

Deepwater drilling remains steady, however. Little change is seen in water depths greater than 600 ft, and the semi utilization rate decreased by only a tenth of a percent over the previous month.

North Sea drilling activity holds steady with 92 rigs working, an increase of eight over last year. Big area of activity now is Norway's Haltenbank area where Norsk Hydro is testing with the Polar Pioneer semi in 1,800 ft waters on Block 6407/7-1.

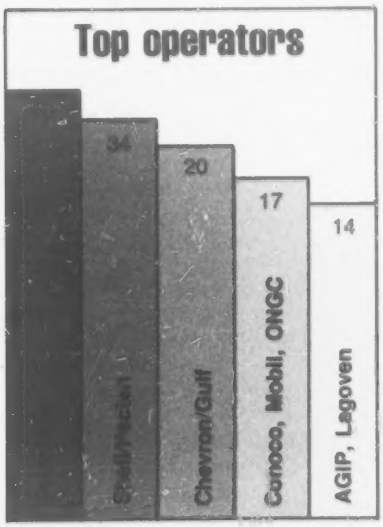
Petrobras regains an earlier lead as top operator with 40 rigs working. Shell/Pecten slips by six rigs over last month, Chevron down by 8. Others increasing rig activity are Mobil, AGIP and Lagoven. □

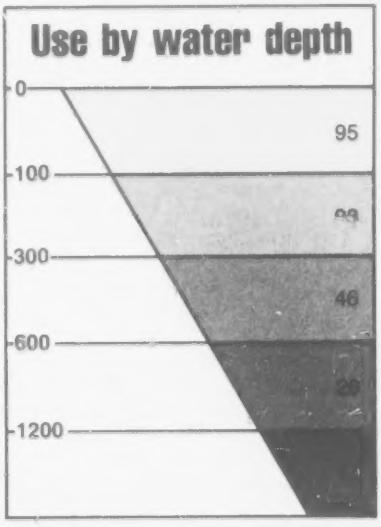
Rig Recap

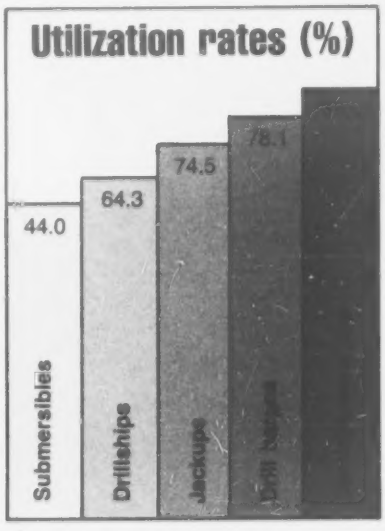
Area	Current Working	Current Idle	Current En Route	One Year Ago Working	One Year Ago Idle	One Year Ago En Route
Africa	22	10	0	26	7	0
East Europe/USSR	22	4	2	21	2	0
Mediterranean	15	16	1 19	8	0	
Middle East	54	26	0	61	21	0
North Sea	92	10	2	83	18	3
Western Europe	5	2	0	1	5	0
Australia/Oceania	3	2	1	5	3	0
Japan	1	1	0	2	0	0
Southeast Asia	55	26	2	58	23	1
Canada/Greenland	8	8	0	9	9	0
Caribbean	2	1	0	1	1	0
Mexico/Cent. America	7	2	0	8	3	0
South America	55	20	1	58	11	0
U.S.						
East Coast	0	0	0	1	0	0
Louisiana	125	45	1	146	14	0
Mafia	8	1	0	8	2	0
Texas	32	38	0	60	21	0
West Coast	1	10	0	9	6	0
Total	507	221	10	577	152	4

Units under construction: Drillships 1, jackups 16, semisubmersibles 25, submersibles 0, other 0; total 42.

Source: Electronic Rig Stats, Feb 11, 1986. Only OCS-rated rigs are surveyed.







Source: Electronic Rig Stats, Feb. 11, 1986. Note: Information on water depth has been furnished to ERS for 321 working rigs.

OFFSHORE RIG REPORT

U.S. Gulf hard hit with cutbacks

INTERNATIONAL rig activity remains relatively steady, though U.S. Gulf utilization has dropped considerably in recent weeks. The North Sea lost seven rigs this month, where activity remains at about last year's level. Little change was seen in Southeast Asia, South America, East Europe and Africa.

The U.S. Gulf has been severely depressed with numerous E&P cutbacks. An additional 23 rigs were idled in the Gulf this month, and 97 fewer rigs are working compared to the same period last year. Day rates are sinking as low as $7,500 for slot-type jackups and $22,500 for semis. The utilization rate could dip below 50 percent with the expiration of numerous one-well contracts.

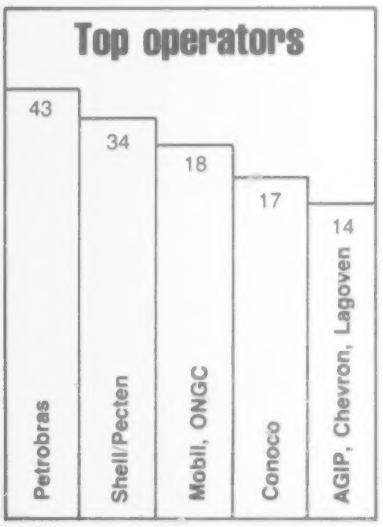
Drillship utilization actually increased to 67.9 percent this month. A steady demand for drill barges continued, but all other categories suffered losses. Submersibles were particularly hard hit, dipping from 44 percent last month to 32 percent. Petrobras remained top operator with Shell Pecten in second place. □

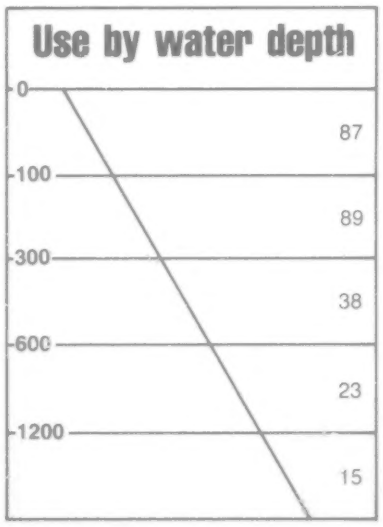
Rig Recap

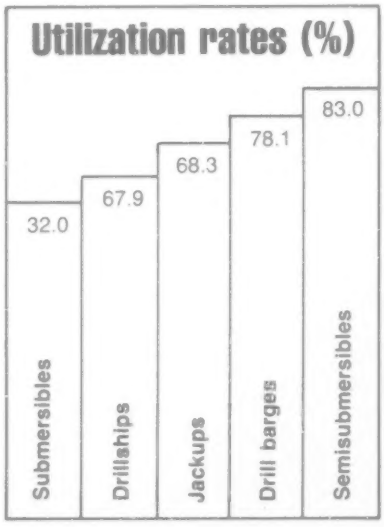
	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	21	10	0	29	4	1
East Europe/USSR	22	4	2	23	3	0
Mediterranean	14	15	0	18	6	0
Middle East	54	24	0	60	22	0
North Sea	85	18	2	86	18	0
Western Europe	4	4	0	1	5	0
Australia/Oceania	5	3	0	6	2	0
Japan	1	1	0	1	1	0
Southeast Asia	56	20	2	61	20	2
Canada/Greenland	9	6	0	7	11	0
Caribbean	2	1	0	1	1	0
Mexico/Cent. America	8	2	0	8	2	0
South America	56	20	2	55	13	1
U.S.						
East Coast	0	0	0	0	0	0
Louisiana	101	63	0	138	24	1
Mafia	9	1	0	9	1	0
Texas	30	42	0	59	21	1
West Coast	0	11	0	7	7	0
Total	472	253	8	569	161	6

Units under construction: Drillships 1, jackups 16, semisubmersibles 25, submersibles 0, other 0; total 42.

Source: Electronic Rig Stats, Jan. 6, 1986. Only OCS-rated rigs are surveyed.







Source: Electronic Rig Stats, March 5, 1986. Note: Information on water depth has been furnished to ERS for 252 working rigs.

OFFSHORE RIG REPORT

Contractors seek stability in 1987

WORLDWIDE RIG activity is continuing its decline though not at dramatic rates seen in the first quarter of 1986. Internationally 394 rigs were working in comparison to 555 in 1985. The North Sea gained 14 rigs in 1986 with a count of 74 units, up from 60 this time a year ago. A drastic drop off occured in the rig count for the Gulf of Mexico on a year to year basis with a total of 97 in April 1986 to 199 in 1985.

Units under construction was decreased by one, a semisubmersible delivered for North Sea work. Sonat has not cancelled any of their rig orders but are watching the situation.

Some contractors are looking for an equilibrium in the supply and demand of the U.S. Gulf rig market by the third quarter of 1987. Speculation rests upon the the ability of OPEC to stabilize oil prices and the prospect of oil companies having to drill their more expensive leases before they run out. Over $2 billion dollars in leases will expire in 1988.

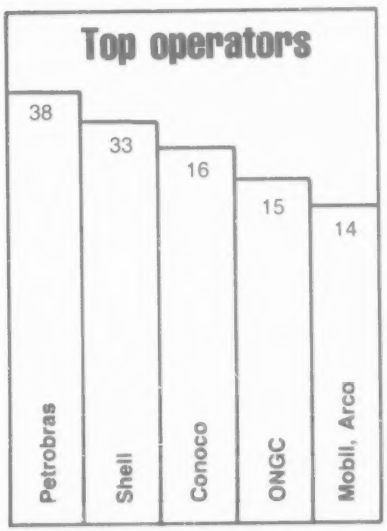
Gulf of Mexico utilization stands at 38.0% and worldwide at 64.0%. □

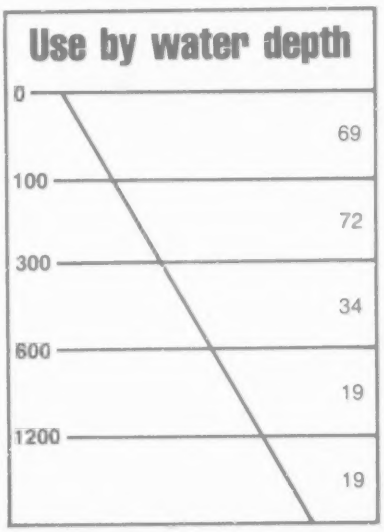
Rig Recap*

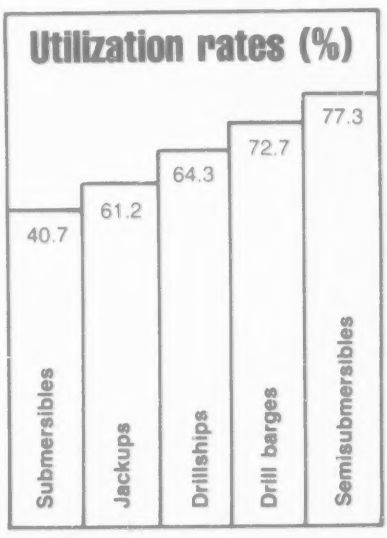
	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	21	10	1	29	6	0
East Europe/USSR	22	0	2	23	3	0
Mediterranean	12	13	1	15	11	2
Middle East	49	23	1	60	19	0
North Sea	74	21	2	84	18	2
Western Europe	2	6	0	1	4	0
Australia/Oceania	6	1	0	6	2	0
Japan	1	0	1	1	1	0
Southeast Asia	52	23	3	62	20	0
Canada/Greenland	9	4	0	5	13	0
Caribbean	1	1	0	1	1	0
Mexico/Cent. America	8	2	0	8	2	0
South America	40	11	0	53	15	1
U.S.						
East Coast	0	0	0	0	0	0
Louisiana	73	88	0	133	34	0
Mafia	6	2	0	11	1	0
Texas	18	52	1	55	19	1
West Coast	0	7	0	8	4	1
Total	394	264	11	555	173	7

Units under construction: Drillships 1, jackups 16, semisubmersibles 24, submersibles 0, other 0; total 41.

*Only OCS rigs are surveyed.







Source. Electronic Rig Stats, April 15, 1986. Note: Information on water depth has been furnished to ERS for 213 working rigs.

Rig contracts not cancelled

DECLINES IN worldwide rig activity continued last month as the total of working rigs fell from 394 to 359. Southeast Asia gained 3 rigs in May from a count of 52 in April. South America and the Eastern Europe and USSR block gained 1 rig each with respective totals of 23 and 41 working units. Louisiana saw the most severe drop-off with a total of 50 working rigs, down from 73 in April. Louisiana's idle rigs rose from 88 to 94. A year ago Lousiana had a total of 130 working rigs with 36 units idle.

Sonat has not cancelled any of their rig orders at this time and have named 2 of their 6 semis under construction. The first unit has been named the Sonat Pratt Rather. Its delivery date is first quarter of 1987. The second semi is named the Sonat George Richardson, scheduled for delivery the second quarter of 1987.

The USSR has emerged as one of the top operators this month with a total of 13 rigs working. Petrobras was first with 38 rigs.

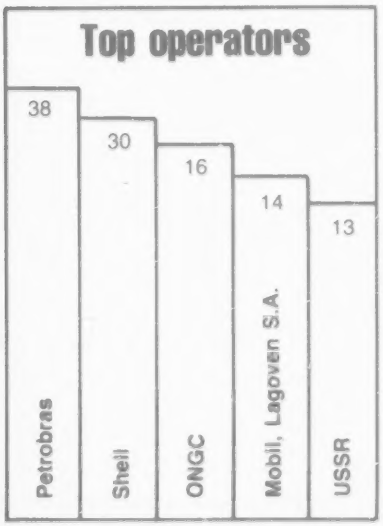
Worldwide utilization rate is 59.9% with the Gulf of Mexico 33.6%. □

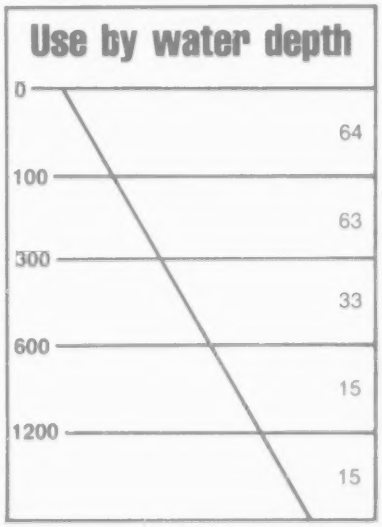
Rig Recap*

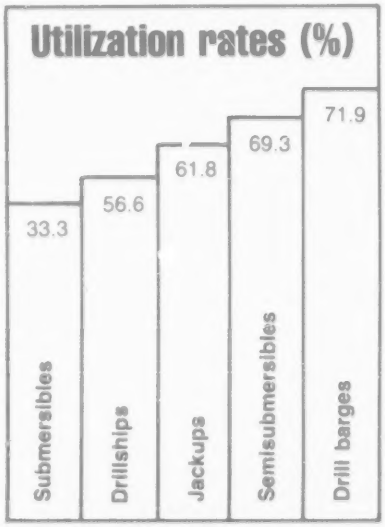
Area	Current Working	Current Idle	Current En Route	One Year Ago Working	One Year Ago Idle	One Year Ago En Route
Africa	18	12	1	30	4	0
East Europe/USSR	23	0	1	23	3	0
Mediterranean	10	12	1	17	11	0
Middle East	45	27	1	61	18	1
North Sea	70	23	2	84	17	1
Western Europe	2	7	0	1	4	1
Australia/Oceania	6	3	0	4	3	2
Japan	0	1	0	1	1	1
Southeast Asia	55	20	3	61	20	1
Canada/Greenland	7	4	1	6	14	0
Caribbean	1	1	0	1	2	0
Mexico/Cent. America	7	2	0	8	2	0
South America	41	11	0	54	18	1
U.S.						
East Coast	0	0	0	0	0	0
Louisiana	50	94	0	130	36	0
Mafia	6	10	0	13	1	0
Texas	20	58	0	49	25	1
West Coast	1	5	0	7	5	0
Total	359	291	10	550	184	8

Units under construction: Drillships 1, jackups 16, semisubmersibles 23, submersibles 0, other 0; total 40.

* *Only OCS rated rigs are surveyed.*







Source: Electronic Rig Stats, May 9, 1986. Note: Information on water depth has been furnished to ERS for 190 working rigs.

OFFSHORE RIG REPORT

Laly semi has uncertain future

LALY/MOHN HAS failed to get financing for its newbuild semi in the Trosvik yard. Laly had negotiated a charter for the rig through Conoco. Laly attempted to transfer the contract to a Norcem semi being built in Japan but Conoco refused. Laly has stopped payments to the Trosvik yard as of May. It appears that Laly and Trosvik will end up in court to decide who will pay for the work already completed on the semi.

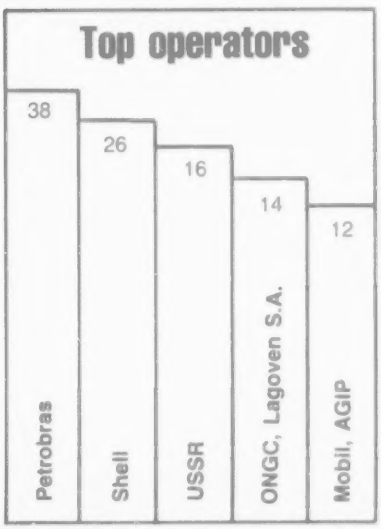
The total number of working rigs stands at 353 units. Eastern Europe and the USSR gained three rigs, up from 23 last month. In the U.S., Texas continued to drop with 17 rigs working, down 3 from the previous month. Louisiana had the only increase with a count of 52 rigs, up two from May. The North Sea continues to follow the trend of the U.S. Gulf showing a decline of nine rigs in June with 61 units working. A year ago the North Sea had 93 rigs contracted.

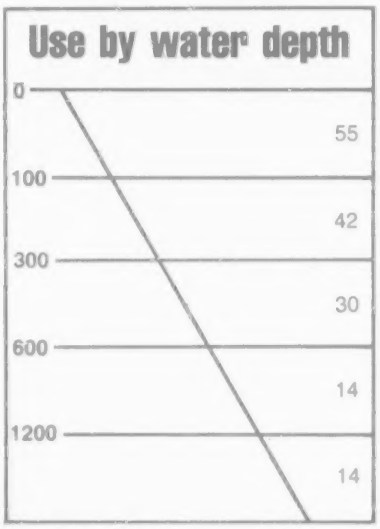
Utilization rose in June for drillships and drill barges by 4.6% and 11.4% respectively. Jackups stand at 55.2%, down from 61.8% in May. □

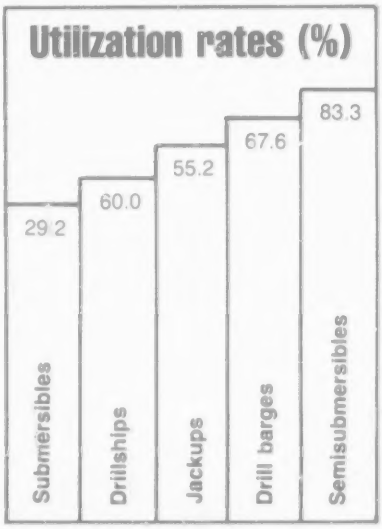
Mobile rig recap (OCS-rated only)

	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
East Europe/USSR	26	0	0	24	3	0
Mediterranean	12	12	0	16	11	1
Middle East	43	30	0	59	19	2
North Sea	61	26	4	93	8	1
Western Europe	2	7	0	2	4	1
Australia/Oceania	6	3	0	6	2	1
Far East/SE Asia	54	25	3	62	21	1
Canada/Greenland	7	4	0	10	10	0
Caribbean/C. America	9	3	0	9	5	0
South America	43	8	0	54	17	2
United States						
East Coast	0	0	0	0	0	0
Louisiana	52	95	0	120	37	0
Mafia	6	13	0	14	3	0
Texas	17	55	0	52	29	0
West Coast	1	6	0	6	4	1
Total	**353**	**300**	**7**	**556**	**179**	**10**

Units under construction: Drillships 1, Jackups 16, Semis 24; Total 41.
Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. Data also in Worldwide Offshore Rigfinder. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats, June 6, 1986. Note: Information on water depth has been furnished to ERS for 155 working rigs.

OFFSHORE RIG REPORT

Revisions for previous issues

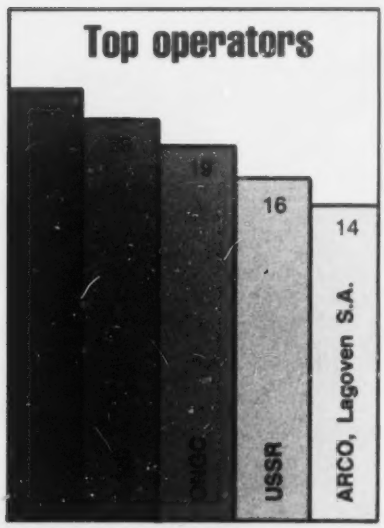
THE FOLLOWING are revisions for the number of rigs working in *Offshore* Rig Recap 1986, May, June and July issues:

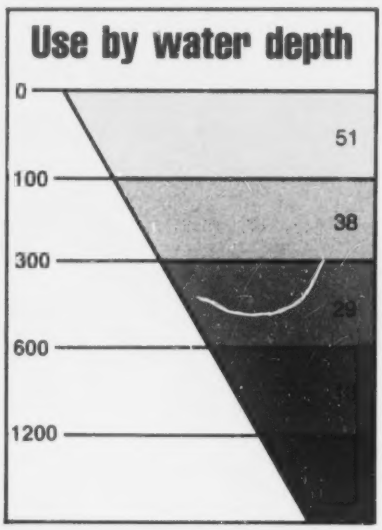
Area	May	June	July
Africa	23	20	19
E.Europe/USSR	26	27	28
Mediterranean	14	13	15
Mid East	56	50	47
North Sea	81	80	75
W. Europe	4	3	3
Australia/ Oceania	7	6	6
Japan/S.E. Asia	57	61	60
Canada/Greenland	12	10	10
Caribbean/Mexico/ Central America	9	9	9
South America	64	65	67
United States			
East Coast	0	0	0
Louisiana	76	55	56
Mafla	8	7	7
Texas	18	21	18
West Coast	2	4	4
Totals	**457**	**431**	**424**

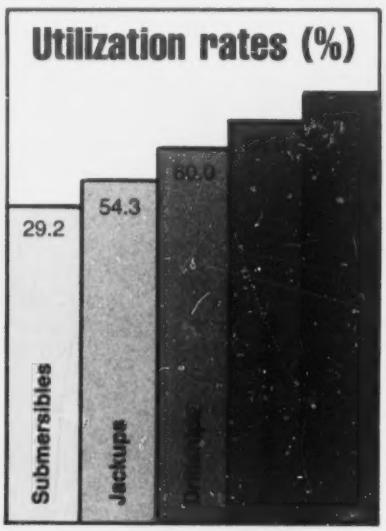
Mobile rig recap (OCS-rated only)

Area	Current Working	Current Idle	Current En Route	One Year Ago Working	One Year Ago Idle	One Year Ago En Route
Africa	18	13	0	30	5	0
East Europe/USSR	29	0	0	24	3	0
Mediterranean	15	11	1	19	17	1
Middle East	45	32	0	59	21	2
North Sea	74	30	3	87	13	0
Western Europe	2	4	0	2	5	0
Australia/Oceania	6	3	0	8	0	0
Far East/SE Asia	56	26	1	53	28	3
Canada/Greenland	10	4	0	10	11	0
Caribbean/C. America	10	3	0	8	3	0
South America	67	8	1	55	18	2
United States						
East Coast	0	0	0	0	0	0
Louisiana	46	129	1	113	37	1
Mafla	4	11	0	12	4	0
Texas	15	28	1	61	27	1
West Coast	2	5	0	10	1	0
Total	**399**	**307**	**8**	**551**	**183**	**10**

Units under construction: Drillships 1, Jackups 16, Semis 23; Total 40.
Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats, July 14, 1986.

OFFSHORE RIG REPORT

North Sea rigs see less activity

THE NORTH SEA showed more signs of a slowdown in August. The number of working rigs dropped to 68, down six from last month's tally. The U.S. Gulf figures stayed in the same range with Louisiana losing two units and Mafla gaining one.

Semisubmersible and submersible utilization rates suffered, falling 5% and 8% respectively.

South America's drilling activity continues to rise. Working rigs are up by one with a total of 68. This time last year, South America had 55 active. Eastern Europe, USSR, Canada and the Caribbean had no change in the number of rigs, working, idle or en route.

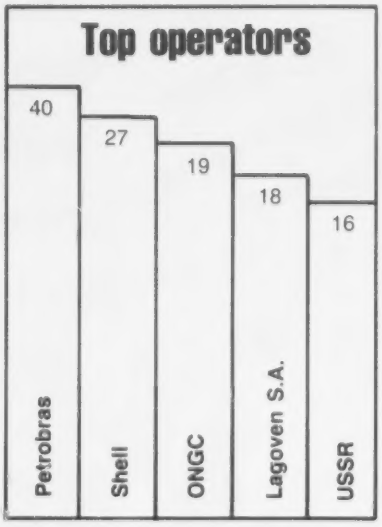
Gulf of Mexico contractors maintain activity with help from the independent oil companies. Houston-based contractor, Cliff's Drilling, added to the staff this year instead of the now-customary lay offs.

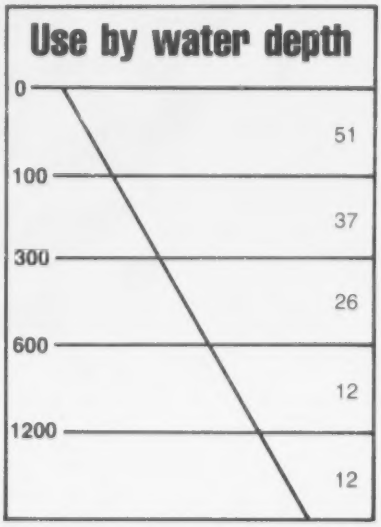
"The independents are generally looking for people to take an interest in the deal and drill the well for them," says Cliff's vice president, Douglas Swanson. □

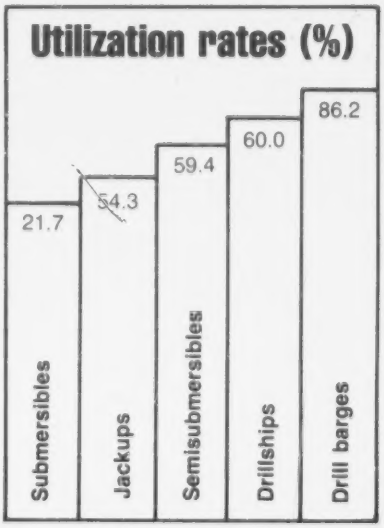
Mobile rig recap (OCS-rated only)

	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	18	12	0	27	7	1
East Europe/USSR	29	0	0	24	4	0
Mediterranean	14	12	1	21	5	2
Middle East	43	34	0	60	20	1
North Sea	68	34	5	94	3	2
Western Europe	2	5	0	3	4	0
Australia/Oceania	6	3	0	8	0	0
Far East/SE Asia	54	26	1	53	27	4
Canada/Greenland	10	4	0	13	8	0
Caribbean/C. America	10	3	0	9	3	0
South America	68	7	1	55	19	1
United States						
East Coast	0	0	0	0	0	0
Louisiana	42	128	0	114	50	0
Mafla	5	13	0	16	2	0
Texas	15	27	0	46	27	1
West Coast	1	6	0	10	1	0
Total	**385**	**314**	**8**	**553**	**180**	**12**

Units under construction: Drillships 1, Jackups 14, Semis 22; Total 37. Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats August 8, 1986. Note: Information on water depth has been furnished to ERS for 138 working rigs.

OFFSHORE RIG REPORT

U.S. Gulf shows activity upswing

LOUISIANA IS A new bright spot in the U. S. Gulf offshore picture with a sizeable increase in rig activity. The Louisiana offshore rig count rose by 12 units in September. It appears independent operators are busily drilling short-fuse farmouts from major oil companies. With independent operators such as Corpus Christi Exploration and TXP Operating bidding at the recent Western U.S. Gulf lease sale, this trend should continue to strengthen in the next few years.

Utilization rates fell for all types of units with the exception of jackups, rising less than 1% from last month.

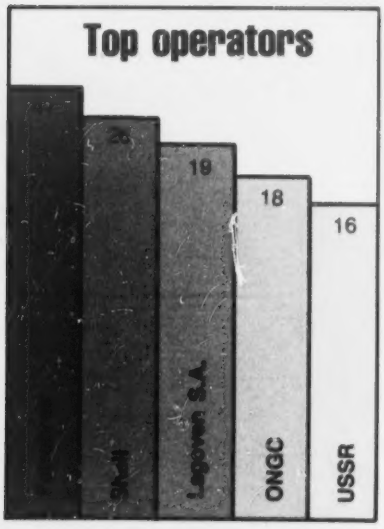
The number of rigs working internationally fell from 385 units to 373. The Middle East took the steepest drop with only 37 rigs working offshore compared to 48 last month. This time last year 546 rigs were working worldwide.

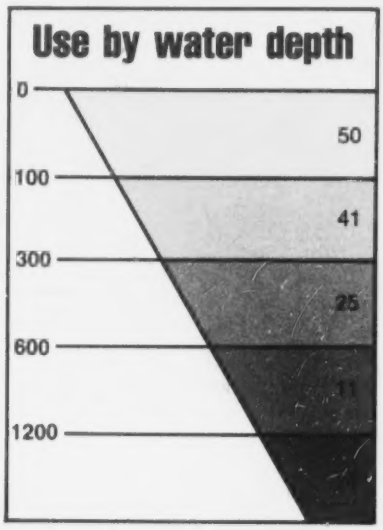
The number of units under construction has changed with the delayed launching of Transworld's Mr. Mac jackup and Transocean 8 semi. Both unit's delivery dates have been pushed back to November 1987. □

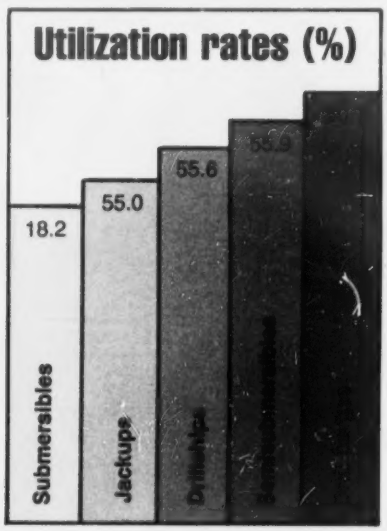
Mobile rig recap (OCS-rated only)

	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	17	15	1	27	7	1
East Europe/USSR	29	0	0	24	4	1
Mediterranean	13	13	0	22	6	0
Middle East	37	39	0	60	20	2
North Sea	61	41	2	90	7	1
Western Europe	3	4	0	4	4	0
Australia/Oceania	6	3	0	5	2	0
Far East/SE Asia	50	29	2	57	26	5
Canada/Greenland	6	7	0	11	10	0
Caribbean/C. America	10	3	0	8	3	0
South America	68	8	0	55	19	1
United States						
East Coast	0	0	0	0	0	0
Louisiana	55	116	0	121	50	2
Mafia	4	8	0	13	4	0
Texas	12	27	0	40	25	0
West Coast	0	8	0	9	2	0
Total	**371**	**321**	**5**	**546**	**189**	**13**

Units under construction: Drillships 1, Jackups 15, Semis 22; Total 38.
Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats, Sept. 3, 1986. Note: Information on water depth has been furnished to ERS for 141 working rigs.

OFFSHORE RIG REPORT

Drilling pace stabilizing

ONLY SLIGHT increases in worldwide drilling activity were seen in October. Louisiana continues to be the front runner in activity with the addition of 6 units over last month. The North Sea remains at relatively low levels with 62 rigs working, down from the 91 units working at the same time last year. The Middle East continues to drop with the loss of 4 rigs in October.

Petrobras and Shell continue to be active in offshore drilling with 40 and 23 wells drilling respectively. Mobil enters into the count this month with 9 wells drilling in October. The USSR advances its position with an increase of 4 wells from 13 to 17.

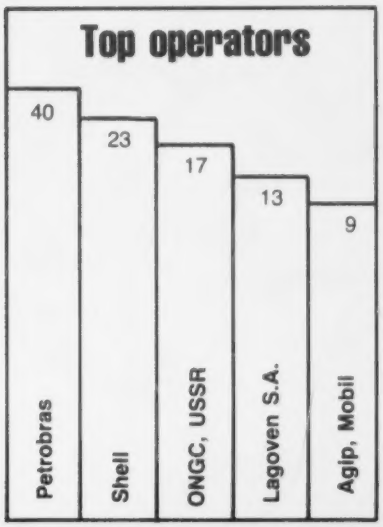
Utilization rates fell for all offshore units except submersibles which increased by 2.2%. Drillships saw the steepest drop from 55.6% to 50.0% in October.

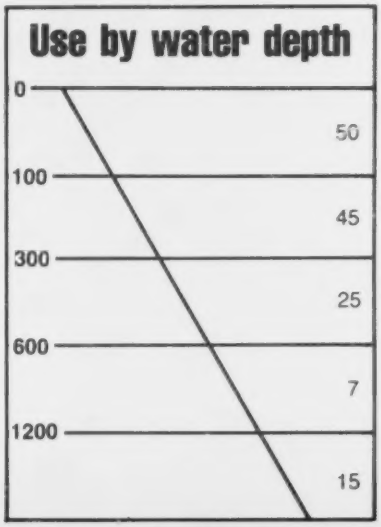
The number of rigs being built continues to fall with the total count dropping from 38 to 35 this month due to deliveries and cancellations. Contracts for two semisubmersibles have been cancelled. □

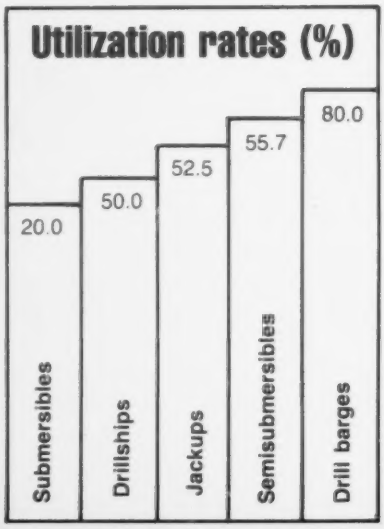
Mobile rig recap (OCS-rated rigs only)

	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	17	14	1	23	8	2
East Europe/USSR	30	0	1	24	5	0
Mediterranean	12	13	0	19	9	2
Middle East	33	41	0	57	22	2
North Sea	62	40	0	91	5	1
Western Europe	3	6	0	5	4	0
Australia/Oceania	4	4	0	7	1	1
Far East/SE Asia	46	33	2	58	24	3
Canada/Greenland	5	7	1	11	6	4
Caribbean/ C. America	9	3	0	8	3	0
South America	69	7	2	52	21	2
United States						
East Coast	0	0	0	0	0	0
Louisiana	61	108	0	127	48	0
Mafia	1	9	0	10	3	0
Texas	11	24	0	41	27	0
West Coast	0	8	0	9	2	0
Total	**363**	**317**	**7**	**542**	**188**	**17**

Units under construction: Drillships 1, Jackups 14, Semis 20; **Total 35.**
Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats, Oct. 13, 1986. Note: Information on water depth has been furnished to ERS for 142 working rigs.

OFFSHORE RIG REPORT

Year-end drilling spurs rig activity

SOUTH AMERICA gained 5 rigs in November for a total of 74 rigs drilling, compared to only 57 a year ago. Far East/Southeast Asia saw more drilling with 49 units active, up from the 46 working last month. The North Sea witnessed a dramatic drop in drilling activity to 52 rigs, a loss of 10 compared to 62 drilling last month. Activity in the United States rose generally for November with Louisiana increasing by 3, Mafla by 1 and Texas by 2.

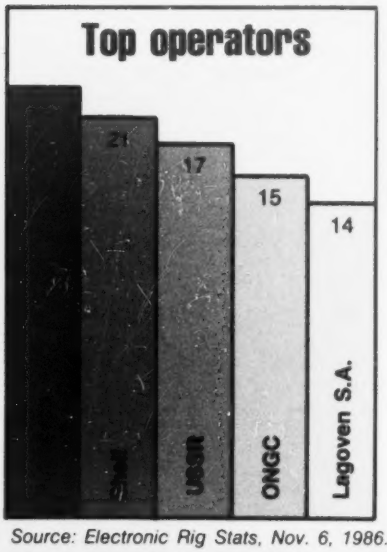
Drill barge utilization rose by nearly 10% with an increase to 89.7% from 80% in October. Operators drilling shallow, yearend prospects can be attributed to the rise. The utilization rate for jackups and drillships rose by 1.4% and 2.1% respectively. Submersibles showed the most severe loss with rates falling from 20% to 11.8% in November.

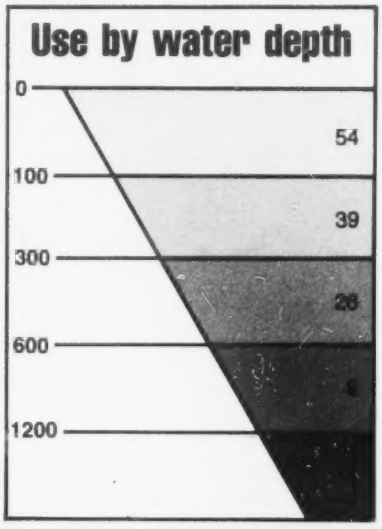
Transworld has agreed to accept delivery of the Gorilla 4 harsh environment jackup from Marathon LeTourneau's Brownsville, Texas yard. The rig was originally scheduled for delivery in August 1986. □

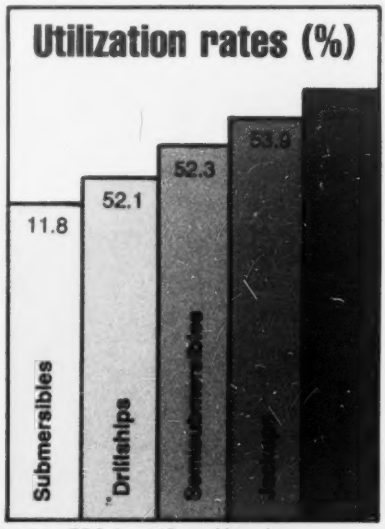
Mobile rig recap (OCS-rated rigs only)

	Current			One Year Ago		
Area	Working	Idle	En Route	Working	Idle	En Route
Africa	17	11	1	23	9	1
East Europe/USSR	30	0	1	23	5	0
Mediterranean	7	17	0	20	12	0
Middle East	35	38	0	54	23	0
North Sea	52	53	3	91	9	2
Western Europe	2	4	0	3	4	1
Australia/Oceania	4	4	1	8	1	0
Far East/SE Asia	49	29	6	56	29	0
Canada/Greenland	3	10	0	14	4	0
Caribbean/C. America	9	3	0	8	3	0
South America	74	5	0	57	17	2
United States						
East Coast	0	0	0	0	0	0
Louisiana	63	104	0	123	39	0
Mafla	2	8	0	13	4	0
Texas	13	26	0	45	31	1
West Coast	0	8	1	5	5	1
Total	**360**	**320**	**13**	**543**	**195**	**8**

Units under construction: Drillships 1, Jackups 14, Semis 20; **Total 35**
Electronic Rig Stats' worldwide mobile rig database available on diskettes for your IBM PC or compatible. For more information contact: Mary Lutz, ERS, P.O. Box 1941, Houston, TX 77251; (713) 621-9720; Telex: 825126 OCEANUF







Source: Electronic Rig Stats, Nov. 6, 1986. Note: Information on water depth has been furnished to ERS for 143 working rigs.

THE WORLD OFFSHORE

Jim Redden
News Editor

Indonesia

Texas Eastern Bawean, Inc., a subsidiary of Texas Eastern Corp. of Houston, has assumed operatorship of the **Bawean Block** offshore northern Java, Indonesia.

Texas Eastern replaced Kerr-McGee as operator of the block. This move marks the first time Texas Eastern has directed the exploration and production activities of a Far Eastern block.

The subsidiary now holds a 60% interest in the 1.85 million acre tract. In conjunction with its increased role in the region, the company was expected to open an office in Jakarta this month.

Texas Eastern, along with partners Tesoro Java Petroleum (25%) and Samedan Oil of Indonesia, Inc. (15%), is continuing to evaluate the block and will drill two more wells in 1986.

United Kingdom

Research and development investment by oil companies in the North Sea presently is worth more than $189 million, according to the UK Department of Energy.

In releasing the figures, Alick Buchanan-Smith, minister of state for energy, praised the industry for its response to the government's emphasis on research and development programs in the ninth round of licensing.

He noted the major elements of the R&D spending included: $47.25 million for seismic and reservoir evaluation techniques, $31.05 million for fixed floating and subsea production systems, $36.45 million for instrumentation and control systems, $16.2 million for inspection, maintenance and repair, $9.45 million for pipelines and $12.15 million for enhanced oil recovery.

Since the ninth round, the Department of Energy noted, several projects have been initiated to advance the understanding of enhanced oil recovery and heavy oil production techniques.

Other projects are designed to study the feasibility of deepwater production west of the Shetland Islands and add to knowledge of deep and fractured deposits through improved seismic techniques.

Concerning the Shetlands, Texaco North Sea U.K. Co. hit two back-to-back oil and natural gas discoveries on Block 3/4A in the North Sea, 100 miles east of the islands. These were the first two wells to be drilled by Britoil plc under a farm-in agreement concluded in June.

The **3/4A-9 discovery** well flowed at a combined rate of 14,033 b/d of 40° and 41° API gravity crude from two intervals in the Brent sandstone through $^{9}/_{16}$-in. and $^{7}/_{8}$-in. chokes respectively. The well also flowed 16.6 MMcfd of gas.

The second discovery well, designated **3/4A-10**, flowed oil and gas from two intervals in the Statfjord sandstone at a combined rate of 6,125 b/d of 40° to 42.5° gravity crude through choke sizes ranging from $^{5}/_{16}$ in. to $^{14}/_{16}$ in. The well also flowed more than 20 MMcfd of gas.

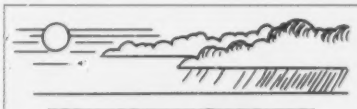
Two additional intervals flowed at a combined rate of 7,415 b/d of 48° to 49° gravity condensate through a $^{3}/_{4}$-in. choke along with 54 MMcfd of gas.

Texaco previously drilled seven wells on the block, all of which confirmed the presence of oil and gas.

Under the farm-in agreement, Britoil acquired from Texaco, as sole licensee, a 16.5% interest in the block with an option to increase its interest to 50%. As part of the contract, Britoil agreed to acquire an estimated 2,040 line miles of seismic and to drill three wells. The second of the wells was being tested in late November and the third was to begin drilling last month.

Further appraisal drilling is scheduled to begin in 1986 upon completion of the farm-in wells drilled by Britoil.

Block 3/4A was acquired by Texaco under License P119 in the third round. Containing proven hydrocarbons in the Brent and Statfjord reservoirs, the block lies between the Brent field, the North Alwyn field



Weather Outlook

North Sea

January is a stormy month for the northern portion of the North Sea, with that area experiencing about two storms per week with winds of 35 knots or greater. Winds of up to 70 knots can be expected once every five years and up to 90 knots once every 20 years. These extreme winds also are accompanied by impressive waves. In the sector of the North Sea exposed to the Atlantic, the 100-year wave is 105 ft.

The southern portion is somewhat quieter with gales occurring only three days out of the month. Wind gusts up to 90 knots can be expected once every 40 years. The waves in this area are limited by the water depth, usually not exceeding 75% of the water depth.

Additionally, there is not as much open water distance for the wind to build higher waves. The 100-year wave is about 60 ft, if the water depth can support it. □

***Source:** Institute for Storm Research, Houston*

and the Ninian field in 450 ft of water.

Hamilton Oil Corp., as operator, and partners have successfully completed the first development well in the Innes field, located on Block 30/24 in the UK North Sea.

Well 30/24-32, a direct offset to the **30/24-24** discovery well, flowed oil at the rate of 3,200 b/d on a $^{40}/_{64}$-in. choke. The well was drilled to a depth of 12,860 ft and completed in the Rotliegendes sandstone. A subsea flowline is being laid and production from the well will be processed through the Transworld 58 floating production facility.

Innes is the smallest oil field so far produced in the North Sea. The discovery well was placed on production in January 1985 and has produced more than 1.2 million bbl of oil to date.

Marathon Oil U.K., Ltd. has completed testing well **16/7a-29** in the Central Brae area.

The well is in 350 ft of water about four miles north of the Brae A platform. It was directionally drilled from a template at **16/7a-27** to a measured depth of 14,982 ft. Two intervals, tested between 14,488 ft and 14,628 ft, flowed 32° oil at a combined rate of 3,807 b/d and 5.25 MMcfd of gas. The well was plugged and abandoned and the Bideford Dolphin rig has been moved to well **16/3b-8.**

The 16/7a-29 is about one mile northeast of Central Brae discovery well **16/7a-3**, which tested four zones at rates of 1,899 to 5,563 b/d of oil with a maximum gas flow of 9.24 MMcfd.

Occidental Petroleum has an oil and gas discovery on UK North Sea **Block 16/12a,** 130 miles northeast of Aberdeen, according to the Scottish Development Agency.

The well tested at a rate of 9,000 b/d of oil and 20.5 MMcfd of gas. The announcement followed close on the heels of Occidental's discovery near the Piper field on Block 15/17. Further appraisal of the latest field was beginning at yearend.

Egypt

Conoco, through its affiliation with Geisum Oil Co., has begun production from the **Geisum field** in the Gulf of Suez.

Total production from three wells is expected to average 7,500 b/d. Three more wells were expected to be completed by early 1986, increasing production to about 11,000 b/d.

Production is from a 650-ton, four-leg platform in 30 ft of water about 20 miles north of Hurghada, Egypt. The platform is connected by an 8-in. pipeline to a permanently moored tanker.

The tanker is in 150 ft of water and holds production, storage and offtake facilities, and living quarters for 70 workers. The tanker is located about two miles east of the platform.

The Geisum field is the first Egyptian oil production for Conoco. The field is operated by Geisum Oil Co., formed by Conoco Geisum Inc. with working interest owners and the Egyptian General Petroleum Corp.

Louisiana

Exxon USA credits successful field management and a 22-well drilling program for increasing to record levels the production from its 30-year-old **South Timbalier Block 54** field, located 38 miles southwest of Grand Isle.

M.E. Foster, mamager of the company's Offshore Production Division, says the field programs have been "a major success." He said by fine tuning operations to maximize flow and by utilizing both platform and jackup drilling rigs, production has been increased to more than 9,700 b/d of oil. That figure represents a threefold increase from the levels of two years ago. He said the upward trend is expected to continue well in 1986 as further drilling and workover programs are completed.

The field was first produced in 1955. It underlies South Timbalier blocks 54, 55, 66 and 67 and presently is being produced from six production platforms and one single-well template in about 65-ft waters.

Elsewhere, Tenneco Oil Exploration and Production has launched initial gas and condensate production from **Ship Shoal Block 97**. Two wells on the recently installed Platform A are producing gas at a combined rate of 25 MMcfd and 700 b/d of condensate.

Peak daily production from the field, located 56 miles south of Morgan City, Louisiana, will exceed 40 MMcfd of gas and 1,000 b/d of condensate. Production is from Miocene age sands between 11,800 and 11,845 ft.

Tenneco acquired the block in the April 1984 federal sale for $2.97 million. The discovery well on the block was announced in February 1985.

Nova Scotia

Mobil Oil Canada, Ltd. has completed testing of wildcat **West Olympia O-51** with gas measuring 21.3 MMcfd through a $^{44}/_{64}$-in. choke from the interval of 14,291-14,391 ft.

The rate declined throughout the test and was measured at 18.7 MMcfd when the test was terminated.

The well was drilled to a depth of 15,800 ft about five miles north of Sable Island.

China

Texaco Inc., as part of the joint venture Pearl River Oil Operating Co., has begun a series of exploratory drilling operations in the South China Sea in what is known as contract area 15/33.

Located in the Pearl River Mouth Basin, contract area 15/33 is about 150 miles southeast of Guangzhou. The four-block area covers about 316,000 acres.

The first of the wildcats, **Xijiang 33-2-1**, is targeted for estimated total depth of 16,400 ft. A second well also is planned in this contract area.

Previous wells drilled in the area between November 1984 and April 1985 did not establish commercial prospects.

The Pearl River Oil Operating Co. consists of Getty Oil International (Orient), Inc., a subsidiary of Texaco, Sun Orient Exploration Co., Texas Eastern Orient Inc., Japex Nanhai Ltd. and Huanan Oil Development Co., Ltd.

California

Sun Exploration and Production, a unit of Sun Oil Co., has a significant oil discovery in the Santa Barbara Channel off Southern California.

Located on the Diablo Prospect, the **OCS P-0467 No. 2** well tested at a combined rate of 1,500 b/d from various pay zones in the Monterey formation. Drilled to a total depth of 16,500 ft, the well encountered two oil-bearing zones in the Monterey formation with a thickness of 3,700 ft.

A 580-ft interval was perforated in the upper zone and produced oil at a consolidated rate of 1,000 b/d with API gravities ranging from 11° to 14°. The lower zone was perforated over a 1,200-ft interval and was tested at a consolidated rate of 500 b/d of oil.

THE WORLD OFFSHORE

Jim Redden
News Editor

Gulf of Mexico

A few months ago industry observers were indicating as many as 300 leases could be awarded in December's Eastern Gulf of Mexico OCS Sale 94.

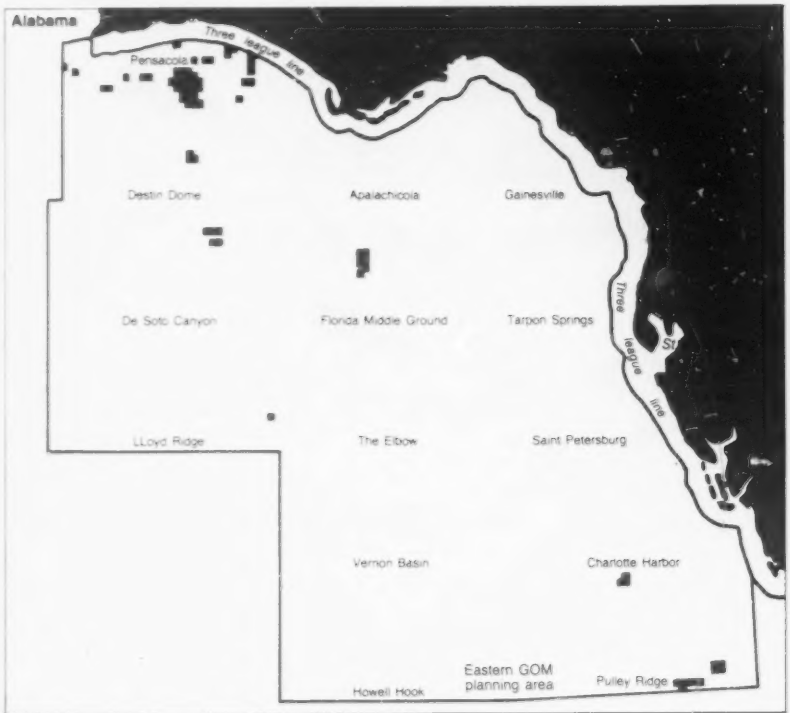
After only 30 minutes, however, oil companies were willing to put up only $124,022,098 in apparent high bids for the rights to drill on 82 predominately gas-prone tracts along the eastern fringes of the gulf. By comparison, that number represents less than half the number of high bids in the 1984 eastern Gulf sale, which netted $310.5 million in high bids.

Total money exposed from all 114 bids offered in the latest sale came to $155.2 million, or less than one-third of the $500.2 million exposed in the 1984 sale.

The result apparently surprised many industry followers who had expected the sale to draw a larger response. Since the primary objective in the eastern Gulf is the deep gas-prone Norphlet sands, which are yielding significant discoveries off Alabama, many felt operators would be rushing to secure more acreage in the theater.

However, growing concern over U.S. taxation issues and dwindling hope in a near-term revival of the gas market are being blamed for keeping oil companies at bay.

One oil company official said others who might have been active either



Top 10 Tracts

Area & block	No. bidders	High bidder	Bonus
Destin Dome Block 66	3	Amoco, Shell	$7,166,000
Pensacola 990	3	Amoco, Shell	$6,566,000
Destin Dome 111	5	Amoco, Shell	$6,167,000
Destin Dome 97	1	Conoco, Pennzoil, Chevron	$5,088,000
Pensacola 958	1	Arco	$3,551,000
Destin Dome 65	1	Amoco, Shell	$3,336,000
Florida Middle Ground 455	1	Tenneco, Texaco, Anadarko	$3,276,000
Pensacola 866	1	Arco	$3,152,000
Pensacola 904	1	Tenneco, Texaco, Anadarko	$2,877,000
Florida Middle Ground 456	1	Tenneco, Texaco, Anadarko	$2,377,000

Weather Outlook

Grand Banks

Large cells of high pressure occupy much of offshore Labrador during the month of February; thus winds blowing from the northwest are predominant throughout most of the region. However, storms are most frequent and intense in February.

The severities of these storms are extremely difficult to predict, but wind gusts of 70 knots with seas up to 60 ft can be experienced. The 100-year wind and wave are 142 knots and 130 ft respectively.

During February, sea states are negligible in zones of partial ice cover and unnavigable ice areas. Since an ice field acts as a filter, which quickly dampens the short-period sea, swells are allowed to penetrate deeper into the ice field. □

***Source:** Institute for Storm Research, Houston*

didn't see the prospects or were too financially strapped to participate.

Shell once again was the big spender in the sale as it was in the 1984 offering. Acting alone or with partners, Shell shelled out $30.6 million in 38 bids. The company was the apparent winner on 13 solo bids and 17 offers with partners.

Amoco, traditionally one of the most active operators in the Gulf, was the second highest bidder with a net exposure of $27.8 million. The company placed offers on 26 blocks and was the apparent winner of 24.

The hottest areas in the sale were the Pensacola and Destin Dome regions off Florida's panhandle. The Pensacola region drew 32 offers on 30 tracts, while bidders made 46 offers on 30 Destin Dome tracts. Many experts believe the areas of the Florida panhandle contain the Norphlet and Smackover sands that are together reaping tremendous success onshore.

According to the Minerals Management Service tally, the highest bid of the day was $7,166,000 offered by a Shell/Amoco consortium for Destin Dome Block 66. The same group bid nearly $32 million for Destin Dome Block 160, which represented the highest bid in the 1984 sale.

In late 1985, Shell completed a tight hole well on Block 160, which many industry observers believe was successful. The Shell/Amoco consortium apparently won 12 of 13 bids placed during the latest offering.

Of those tracts, Shell/Amoco offers on Destin Dome tracts 66, 111 and 65 were the first, third and sixth top bids respectively. The group's offer for Pensacola Block 99 was the second highest offer in the sale.

Shell and Conoco also jointly bid on nine tracts in the unexplored Pulley Ridge sector, apparently winning five blocks. No wells will be allowed in this region until a three-year environmental impact study is completed. Interest in the region, according to bidders, was solely on the basis of seismic indicating Norphlet sands.

Meanwhile, state and industry officials are blaming the lack of seismic and the unattractive gas market for keeping bidders away from the third Mississippi state sale in December. Chevron was the only oil company participating, and the company placed bids on four tracts adjacent to the block it presently holds there.

State officials were anticipating a relatively strong sale, basing their optimism once again on the success operators are enjoying in the Norphlet sands in adjourning Alabama state and federal waters.

Elsewhere in the Gulf, Union Texas Petroleum says tests of a second well drilled on Vermilion Block 237 confirm the discovery of significant natural gas reserves the company made there last year.

The **Vermilion 237 No. 2** confirmation well tested at a combined rate of 15.6 MMcfd of gas and 230 b/d of condensate from three productive zones between 10,088 ft and 11,566 ft. The gas and condensate were tested through varying choke sizes with pressures greater than 4,200 psi.

In July 1985 the company discovered gas in the first well the company drilled on Block 237. At that time Union Texas said the well encountered 53 ft of net pay in two zones between 10,000 and 11,300 ft. The discovery well was not flow tested.

Vermilion Block 237 lies in 130 ft of water, about 62 miles south of Intercoastal City, Louisiana.

Up to three additional wells may be required to fully develop the discovered reserves. Engineering design has been initiated for a permanent production platform on the block. The company estimates that when it is fully developed, the field will be capable of producing gas at rates greater than 100 MMcfd.

In another development, Vanguard Offshore Management Co., a subsidiary of Huthnance Offshore Corp., has completed testing of a gas discovery in federal waters off Louisiana.

The **OCS-G 6840 Well No. 1** located on Chandeleur Block 24 has a calculated open flow potential of 20 MMcfd. The well flowed at 5.5 MMcfd with 1,500 psi flowing tubing pressure through a $^{27}/_{64}$-in. choke.

Production is from a Miocene sand at 4,630 ft. Drilled in 65 ft of water 60 miles northeast of Venice, Louisiana, the discovery well is a joint venture of Vanguard and North Central Oil Corp. under a farm-in agreement from BelNorth Petroleum Corp.

China

Texaco Petroleum Maatschappij (Nederland) B.V., a wholly owned subsidiary of Texaco Inc., has signed a new agreement in Beijing with the China National Offshore Oil Corp. (CNOOC) for additional exploration in the South China Sea.

The contract gives the company a $33^{1}/_{3}$% interest in 10 blocks in **contract area 16/04** in the Pearl River Mouth Basin. Covering an area of about 800,000 acres, the blocks are located approximately 170 miles southeast of the city of Guangzhou.

In the event of commercial discoveries, CNOOC would have the right to assume up to a 51% participating interest in the development areas. Exploratory drilling operations in this area will begin after additional seismic evaluation.

Exploratory rights in China were first granted in December 1983. Exploratory drilling operations are being conducted in **contract area 16/08**, which is contiguous and directly west of 16/04 in the South China Sea. Two oil discoveries were announced last year on contract area 16/08.

Norway

The Norwegian continental shelf has yielded another milestone with the highest flow rate ever recorded for an offshore gas well.

According to operator Norsk Hydro, the production tests were carried out on **well 31/6-8** in the eastern portion of the giant Troll field. Production during the tests reached a record rate of 3.9 million cubic meters per day.

The well was drilled by the semisubmersible Treasure Seeker and temporarily suspended last year.

Norsk Hydro says the main objective of this well was to gain geological information on the southwestern flank of the Troll East reservoir. The data will be used to assess the reservoir's maximum production capacity and to evaluate sand production tendencies downhole.

The tests confirmed the geological prognosis for this part of Troll. A gas column of 88 meters and an oil column of five meters were encountered.

Norsk Hydro said the maximum rate was achieved through a 2-in. by 2-in. choke in an internally gravel packed well. Norsk Hydro also carried out an extensive test in the well without filters to determine more accurately the behavior of the reservoir rock.

Specially designed equipment for high production capacity was used, including a large-bore downhole test valve, large-bore subsea and surface test trees and a vertical separator.□

THE WORLD OFFSHORE

Jim Redden
News Editor

Canada

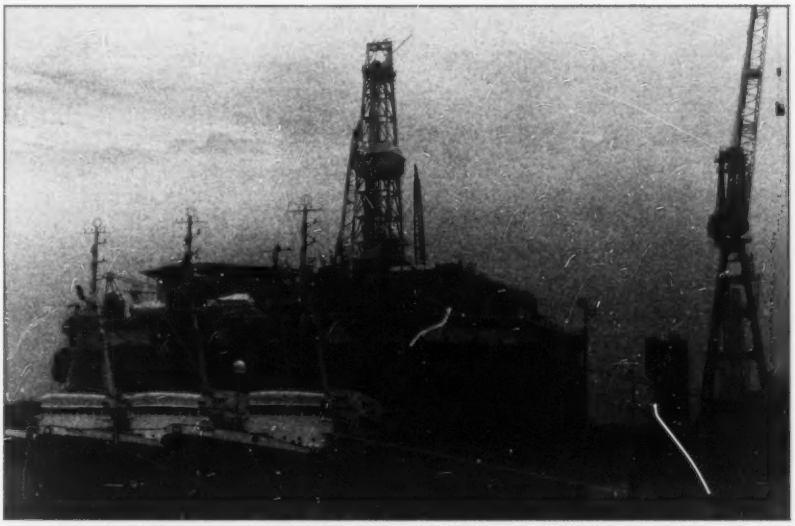
Interest in the Beaufort Sea may be enhanced significantly in the wake of what is being touted as the biggest oil discovery in Canada's history.

Government and industry association spokesmen are calling Gulf Canada Ltd.'s gigantic **Amauligak I-65** the most significant oil discovery in that part of the world. Others say it greatly improves the possibility of production being derived from the icy Beaufort by the 1990's.

In late January, Gulf Canada announced that further tests of three zones resulted in an estimated 83% increase in the expected production capacity of the discovery. Drilled to a total depth of 13,537 ft, Gulf Canada estimates increased production capacity of 34,950 b/d of medium to light crude. These estimated flow rates compare most favorably with the 13,600 b/d estimated production rate of the **Amauligak J-44,** which upon its discovery in 1984 was considered the largest Beaufort find.

The company says the total production rate could reach 80,000 b/d. The company added the Amauligak zone might contain 300-400 million bbl, with a possibility of 700 million bbl.

Gulf Canada says testing of the three additional zones revealed flow rates of 4,814 b/d through a 72/64-in. choke through perforations in an interval of 10,262 ft to 10,452 ft; 7,551 b/d on a 96/64-in. choke at an interval of 11,319 ft to 11,476 ft and 6,831 b/d through a 2-in. choke at an interval of 11,653 ft to 11,703 ft.



The Molikpaq gets underway for tow from a Japanese shipyard to location in the Beaufort Sea. The rig drilled the Amauligak I-65 discovery for Gulf Canada Ltd.

Weather Outlook

Strait of Magellan

In the Southern Hemisphere, March is the beginning of autumn. The Strait of Magellan is located in extreme South America, so March can bring bad weather to the region. Storminess, however, reaches its peak in July and August.

With an advancing storm system, winds will increase from the northwest. With the passage of a storm system, winds shift to the southwest. Winds greater than 30 knots occur 34% of the time, with 10% of these greater than 45 knots. On the average of once every two years, 60 knots or greater will accompany a storm.

Offshore operations within the Strait of Magellan must be concerned with tides. The tidal range each day is 20 ft. During low tide, the wharves are high and dry.

***Source:** Institute for Storm Research, Houston, Texas*

United Kingdom

Hamilton Oil Corp. has completed testing of an exploration well drilled on Block 43/26 in the UK sector.

According to the company, **Well 43/26-3** flowed at the rate of 49.5 MMcfd on a 1-in. choke at a flowing tubing pressure of 2,068 psi. The well is located on a separate structure northeast of the company's initial gas discovery on Block 43/26.

Additional drilling is planned to determine the extent of the gas accumulations on the block.

Meanwhile, Texaco's Block 3/4A in the northern North Sea reportedly has yielded another discovery. **Exploration well 3/4A-10** flowed oil and gas from two Statfjord sand intervals at a cumulative rate of 6,125 b/d of oil and 20 MMcfd of gas. An additional two intervals showed a combined flow rate of 7,415 b/d of oil and 54 MMcfd of gas.

Soviet Union

The Soviet Union is drilling the first wildcat at the Caspian Sea's **Promezhutochnaya** structure that lies along the subsea Apsheron Sill connecting Azerbaijan on the west coast with Turkmenia on the east.

Promezhutochnaya's first well is being drilled by the newly delivered Shelf-3 semisubmersible. The hole is targeted to 16,404 ft in 312 ft of water.

In July 1985 the **Kaverochkin** oil field was discovered on the Apsheron Sill west of Promezhutochnaya. Drilling also has started on the 28 Baku

Commissars structure between Kaverochkin and Promezhutochnaya.

The first major field found on the Apsheron Sill was the giant **Neftianye Kamni** discovery found in 1949. Thirty years later the oil field dubbed the **28th of April**—now the largest Caspian Sea producer—was found just east of Neftianye Kamni.

Later this year the Soviets intend to place 14 additional wells on production at the 28th of April find. That would bring the field's total number of wells to 35 with overall production estimated at 85,000 b/d.

The Promezhutochnaya (Intermediate) is so named because it is about half-way along the Apsheron Sill between the Azerbaijan and Turkmenia coasts. Thus far, the fields off the Turkmenian coast have been relatively small.

Meanwhile, south of the Apsheron Peninsula, the Soviets have completed a confirmation well at the **8th of March** field. Test flow was reported at 740 b/d and nearly 1 MMcfd of gas at a total depth of 18,044 ft.

The field was discovered several years ago and presently has one well on production. Two more holes were being drilled as of last month.

Louisiana

Freeport-McMoRan Energy Partners, Ltd. (FMP), an affiliate of Freeport-McMoRan Inc. has discovered gas on East Cameron Block 311, about 100 miles south of Cameron Parish.

Three exploratory wells drilled in about 200 ft of water on the 5,000-acre lease all encountered gas. The **OCS-G 6646 No. 4 (ST-1A)** well was drilled to a total depth of 8,758 ft and encountered a Pleistocene pay sand which tested, through perforations from 8,606 ft to 8,672 ft, 8.3 MMcfd of gas on a 20/64-in. choke with a flowing tubing pressure of 3,300 psi. The remaining two wells were not tested and development plans are being formulated.

Australia

Production at western Australia's first offshore oil project, the Bond Corp.-backed **Harriet** oil field, has been approved by the State Minister for Minerals and Energy.

While the field, located west of Dampier, is small in world terms, Minister David Parker expects it to make "an important impact."

The Harriet platform was installed in December in WA-192 permit. The design and construction of the platform and associated facilities on Lowendal Island was performed by primarily western Australian companies.

Meanwhile, design work also has started on two satellite platforms to service new discoveries that have extended the field to 10 wells and nearly doubled the initial production rate.

Elsewhere, BHP has abandoned its Skau 2 well in the Timor Sea after a production test only produced water. There presently is no plans to proceed with a Skau 3 well.

Indonesia

Diamond Shamrock Netherlands Petroleum B.V., the Dutch exploration arm of Diamond Shamrock International Petroleum Co., has signed a production sharing contract with state company Pertamina to explore for oil and gas onshore and offshore the Aru Islands south of Irian Jaya.

The Diamond Shamrock subsidiary will serve as operator and holds a 60% interest in the contract area located in the Indonesian portion of the Arafura Sea.

India

The state-owned Oil and Natural Gas Commission (ONGC) has struck gas at its deep **Tatipaka-1** well in the Krishna Godavari Basin.

Gas flow was tested at the rate of 143,000 cubic meters/day.

Meanwhile, an estimated 27 blocks on the east and west coast of the nation are likely to be offered for exploration to foreign operators in the third round of bidding.

The list of blocks to be offered on a production-sharing basis and the main conditions were awaiting governmental approval was of early last month.

According to government sources, the blocks to be offered are located in basins which are less explored, but are known for the presence of oil and gas.

Texas

Transco Exploration Partners Ltd. (TXP) has drilled its first successful gas well on North Padre Island Block A-43, 35 miles off Corpus Christi.

The **A-43 No.1** well was drilled in 209 ft of water to a total depth of 6,420 ft. Log and test results indicated 71 ft of net gas pay from five middle Miocene zones at depths ranging from 5,660 ft to 6,190 ft.

TXP says the well is located 4,500 ft west-northwest of the company's producing platform on the adjacent A-42 block and extends the underlying field. Transco acquired Block A-42 in August 1978 under a farm-in arrangement and discovered gas in April 1979. The block began production in April 1982 and is producing 45 MMcfd.

The company is drilling a second well on Block A-43 in an effort to extend the Block A-42 field further and to explore for new potential reservoirs. TXP and Energy Development Corp. acquired the Block A-43 in the August 1985 OCS lease sale for a sale-high bid of $17.3 million.

Vietnam

Vietnam reported last month it expects to begin commercial production of its **White Tiger** oil field in the South China Sea early this year. White Tiger is located 75 miles offshore between the port of Vung Tau and Kon Dao island to the south.

The first fixed platform at White Tiger was completed in the fall of 1985. No details on the development of the field have been disclosed.

Elsewhere, Hanoi reports geologists have encouraging prospects for more oil and gas in the Hanoi trough and adjacent offshore Beibu (Tonkin) Gulf area of northeastern Vietnam. Hydrocarbon shows were first reported in a Hanoi trough well completed in 1975.

THE WORLD OFFSHORE

Jim Redden
News Editor

California

The tides may be changing in California as more residents apparently feel it is fruitless to oppose offshore development in the oil-rich southern portion of the state.

According to a recent article in the Santa Barbara newspaper, "Both proponents and opponents agree there is a lot of oil just off the county coastline and it will be pumped. Thoughts of actually preventing the drilling no longer hold water, particularly with the administration in Washington and a president whose ranch overlooks all that oil pushing for maximum development for fiscal and defense reasons. The question, both sides agree, is the role of county government in regulating the coming development and whether it has done an adequate job so far."

Despite the seemingly unending attempts to keep the state's coastline out of the hands of drillers, "the basics of energy requirements and the national interest will assure that such developments will ultimately occur," adds Walter E. Gray, president of Diverless Systems Inc.

Addressing the recent Association of Diving Contractors conference and exhibition in Houston, Gray reinforced the importance of the California offshore theater in the world's energy scheme.

"Industry estimates , characterized as conservative, say that offshore reservoirs contain 30% of the total hydrocarbon resources of the world and that 90% of those are not yet discovered," he said. "Offshore California is generally listed as being one of the seven most attractive offshore areas in the world."

Meanwhile, while there presently have been 19 platforms located between San Pedro and Point Conception starting in 1958, most of these are limited producers from relatively shallow formations. The higher potential, Gray reasons, appears to be from the deeper geology of the Miocene Monterey zones west of Santa Barbara in generally southeast-northwest trends. The single Hondo platform. for instance, in these formations currently produces about 40% of the oil produced from all these other platforms combined.

Additionally, the much discussed discoveries off Point Arguello, Point Conception and Point Sal are all located in these deeper formations.

The Monterey is described as highly convoluted and therefore quite challenging to the geologist. Conventional thinking is there probably are a number of comparable reservoirs both north and south of the present finds, but these will not be explored until the highly restrictive leasing requirements are relaxed, Gray noted.

"Current finds are typically classified in the 500 million bbl range, the same as the original estimates for the North Slope, which eventually were enlarged to some 10 billion bbl, recoverable," Gray said. "This is not to say that such an escalation will take place, but it is an indication of potential."

Peak drilling occurred in the 1982-83 period which saw 12 rigs active. Today five or six rigs are working on the average with at least four stacked. Water depths range from less than 100 ft in state lands to depths of more than 3,000 ft or more

Weather Outlook

South China Sea

During April, the northeast monsoon dominates the southern portion of the South China Sea, bringing constantly blowing winds and bad weather. Winds are generally from the north and northeast directions at speeds of 15 to 25 knots. Waves associated with the monsoon are usually over five feet with a persistent swell of three to four feet.

Tide conditions are dangerous on the west coast and have a range of up to 10 ft. Tides on the eastern shores are not as high, but have a range of up to five feet. Currents on the eastern and southern shores are extremely strong, due to the many reefs and outcroppings. □

in the OCS waters well within sight of land.

Most of the construction plans for the region now are concentrated on state lands or the Santa Maria Basin.

In the Santa Maria Basin, Exxon intends to install two platforms in the Santa Ynez Field in 1,000 and 1,200 ft waters. Chevron will install two units in 430 ft and 680 ft waters, while Texaco is in the process of installing one in 670 ft. Union also is installing a platform in 260 ft.

There also appears to be the probability of perhaps five more being installed over the next five years in the Santa Maria Basin and there probably will be one major marine terminal installed by Exxon in that area.

Plans throughout the rest of the Santa Barbara Channel show Arco intending to install four platforms in state waters, Shell one platform and the possibility of four to eight more being installed by other companies within the southern California sector.

In a related development, even though the state's offshore fields showed a slight decline last year, total 1985 crude production in California reached a record 425 million bbl, compared to 412.4 million bbl in 1984.

U.K.

Conoco (U.K.) Ltd. says its **No. 6 well on U.K. Block 48/11b** has tested at 44.2 MMcfd through a 1-in. choke from the Rotliegendes formation.

The gas appraisal well was drilled in 79 ft of water to a depth of 9,405 ft and is located 1½ mile northwest of the discovery well, **48/11b No. 4**. Both the discovery and appraisal wells are located about 40 miles northeast of Mablethorpe, Lincolnshire.

Sovereign Oil and Gas has a success with its fourth well on U.K. **Block 21/3a**, which is 20 miles west of the Forties Field.

The well tested gas condensate from a 40 ft. interval at a rate of 44.5 MMcfd has and 3,000 bbl/d of condensate through a 56/64-in choke.

Louisiana

Noble Affiliates Inc.'s exploration and production subsidiary Samedan Oil Corp., has a gas discovery on Vermilion Block 120, located approximately 30 miles offshore Louisiana.

The discovery well, **OCS-G 4790 Well No. 2** was drilled in 70 ft of water to a total depth of 8,000 ft and encountered 34 ft of net gas pay in a 47-ft gross sand interval. The well tested gas at a rate of 14.1 MMcfd through a 31/64-in. choke with 2,300 psi flowing tubing pressure. A production facility is expected to be installed later this year and gas sales are expected to commence during the fourth quarter.

Texaco has a Middle Miocene gas discovery on South Marsh Island Block 222.

The **OCS-0310 Well No. 125** was tested at a rate of 4.2 MMcfd of gas through a 12/64-in choke. Drilled to a total depth of 14,080 ft, the well was tested through an interval between 12,636 ft and 12,658 ft. Four additional zones in the well were tested at an average rate per zone of 2.1 MMcfd.

The well is located about 115 miles southwest of New Orleans, eight miles offshore. The well was drilled in 15 ft of water, about three miles southeast of Tiger Shoal field on federal lease OCS-0310.

Union Texas Petroleum, meanwhile, has confirmed a 1983 gas discovery in state waters off St. Mary Parish, Louisiana. The **East Lake Sand Lease 10251 No. 2** tested 7.6 MMcfd of gas and 60 bbl of condensate/day through a 11/64-in choke with 12,900 psi flowing tubing pressure from perforations between 17,700 ft and 17,720 ft.

India

After substantially relaxing its terms, the Indian government is presently soliciting bids from foreign operators for 27 offshore blocks.

The blocks to be awarded are located in six basins along the east and west coasts of India. The largest number of eight blocks are being offered in the Korala-Konkan Basin, followed by seven in the Krishna-Godavari Basin, five in the Cauvery Basin, four in Mahanadi, two in Polar and one in the Saurashtra Basin.

According to the terms, the foreign companies will be permitted to bid for one or more blocks, singly or in association with other companies and assignments will be permitted.

In contrast to the two previous offerings, the latest bidding program includes more liberal terms, including fiscal concessions. Under the terms of the new contract, there will be no signature or production bonus, no royalty payment and no minimum expenditure commitment for foreign companies.

Chandra Shekhar Singh, minister of state for petroleum, said foreign companies are expected to bring the latest technology as well as foreign capital investment. The terms for bidding were made more attractive because of the poor response to earlier offerings, he said.

Ireland

While other regions bemoan the present state of the offshore drilling industry, offshore Ireland could see a record year of activity.

During 1986, operators already have guaranteed they will punch at least 10 wells in the Irish sector with the possibility of 16. Most of the wells will be concentrated in the Celtic Sea.

Meanwhile, Chevron (Gulf) has completed its test program on Celtic Sea wildcat **50/6-1**. Tests over an undisclosed interval flowed oil at the rate of 2,074 b/d along with 1.3 MMcfd gas.

Recoverable reserve estimates of 50 million bbl have been attributed to the field, but Chevron will not comment on these estimates.

China

The ACT Operators Group has confirmed an oil and gas discovery in the South China Sea contract area 16/08.

According to the group, the well is located 170 miles southeast of Guangzhou in the Pearl River Basin. Known as **Huizhou 21-1-2**, the well tested crude from multiple zones at a combined rate of more than 9,000 b/d through choke sizes ranging from 3/16-in to 1¼-in. Gravity of the oil ranged from 45.6° to 47° gravity with high wax content.

The well also tested natural gas from an additional zone at a rate of 13.4 MMcfd, along with 840 b/d of condensate.

Huizhou 21-1-2 is the fifth well to be drilled in contract area 16/08 since the ACT group began drilling in October 1984. Drilled in 370 ft of water, it is located about one mile southeast of the discovery well **Huizhou 21-1-1**.

ACT Operators Group consists of Agip (Overseas) Ltd., Chevron Overseas Petroleum Ltd., and Texaco Petroleum Maatschappij (Nederland) B.V. □

THE WORLD OFFSHORE

Jim Redden
News Editor

Antarctic

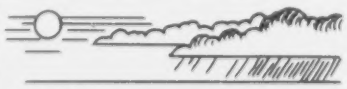
Technological advances may allow the economic exploitation of offshore oil and gas reserves in the Antarctic, the Australian Senate Standing Committee on Natural Resources reported recently.

The report on the natural resources of the Australian Antarctic Territory said there could be such exploration in the short to medium term future. The decision to drill in the region, however, hinges on resolving several political, environmental and legal questions.

Sen. Olive Zakharov, chairman of the committee, said evidence presented to the panel pointed out the inadequacies in Antarctic environmental protection. To rectify this, the committee had recommended a conservation convention be adopted by the Antarctic Treaty nations to coordinate and strengthen envrionmental protection measures while permitting resource exploitation under stringent controls and procedures.

Many analysts believe Antarctica holds the potential for enormous reserves. Additionally, they say the technology is available to effectively explore the offshore sector.

This desolate environment in Antarctic may be the world's next frontier for petroleum development. The technology is available, as evidenced by these research planes attending a scientific research base.



Weather outlook

West coast of Africa

With May being the last month of the wet season, rainfall will average 10-in. with precipitation decreasing thereafter. From June through September, a total of only six inches can be expected.

Light winds from the south occur during the month with significant waves of 2-3 feet. However, wind gusts of 70 kts may accompany isolated thunderstorms, which occur approximately three times a month during the wet season. Large swells are common off the west coast, originating in the South Atlantic near South America and traveling northeast. □

Source: Institute for Storm Research

U.K.

Increased exploration activities in the U.K. sector of the North Sea this year has recently resulted in several significant discoveries.

Britoil and the Texaco North Sea U. K. group have a discovery in block 3/4A, located 100 miles east of the Shetland Islands. This is the third successful exploratory well drilled by Britoil under a farm-in agreement.

The new well, designated **3/4A-11**, flowed condensate at a rate of 4,485 b/d and 25 MMcfd of gas through a 52/64-in. choke. The gas/condensate ratio is 5,640 cu.ft. per bbl.

Under the farm-in agreement, Britoil acquired from Texaco, as sole licensee, 16.5% interest in the block with the option to increase its interest to 50%. Britoil has now completed the three wells it was obligated to drill as part of the agreement.

Last November, Texaco completed two wildcats, designated **3/4A-9** and **3/4-10**, both of which established oil and gas reserves. The seven wells drilled during previous exploratory operations by Texaco in block 3/4A also were successful in confirming the presence of oil and gas.

Block 3/4A contains proven hydrocarbons in the Brent and Stafford reservoirs and lies between the Brent, North Alwyn and Ninian fields in a water depth of about 320 ft. Further appraisal drilling will be undertaken by Texaco as operator later this year.

Meanwhile, results from an appraisal well on Block 16/12A showed stabilized flow rates in excess of 12,000 b/d and 7 MMcfd of gas. A three-dimensional seismic survey and further appraisal drilling is planned before a developmental decision is made by the group headed by Occidental Petroleum (Caledonia) Ltd.

Well 16/12A-9 was drilled to a depth of 14,278 ft and tested at a stabilized rate of 12,338 b/d of 35° API gravity crude and 7 MMcfd of gas through a 1.5-in. choke from a 385-ft. interval.

Another appraisal well, **16/12A-11**, was spudded in March to determine the western limit of the field and is expected to be completed late this month.

Occidental, as operator, holds a 21.42% interest in the field and says the appraisal program probably will continue despite the current low oil prices. The company said the possible development of the field is viewed as a long-term project to be completed in the late 1980's or early 1990's.

The discovery well, **16/12A-8**, was made in October and flowed at stabilized rates of 9,000 b/d of 38.6° gravi-

ty crude and 20.5 MMcfd of gas through a 1-in. choke. The discovery is 130 miles northeast of Aberdeen.

Hamilton Oil Corp. also has encouraging test results from a wildcat drilled on Block 43/26.

Well **43/26-5** flowed gas at the rate of 40.2 MMcfd on a 56/64-in. choke with a flowing tubing pressure of 2260 psi. The well is located about two miles from the discovery well **43/26-3**, which was completed in December, testing 49.5 MMcfd of gas.

Phillips Petroleum Co. U.K. Ltd., operator for a five-company group, has completed testing the **30/7A-7** Judy appraisal well.

The Judy field is located on Block 30/7A on the outer edge of the U.K. continental shelf and 40 miles northwest of the Ekofisk complex in Norwegian waters. Well 30/7A-7 is the second successful appraisal well to be drilled on the structure and was completed to a total depth of 13,500 ft. in 242 ft of water. Tests were conducted from two separate geological zones.

The first test, over an interval below 11,00 ft., flowed 42.5° gravity oil at the rate of 4,168 b/d and gas at the rate of 22.64 MMcfd on a ¾-in. choke.

A second test, over an interval below 9,000 ft., tested 4,584 b/d of 46° gravity oil and 18.6 MMcfd of gas.

According to Phillips, a 3D seismic survey will be undertaken over Block 30/7A this summer.

Louisiana

Diamond Shamrock Offshore Partners Limited Partnership has begun oil production from a platform operated by Mobil.

Production from the **Grand Isle Blocks 20/21** platform is averaging 3,200 b/d of oil and 4 MMcfd of casinghead gas from three completed wells.

The Diamond Shamrock partnership holds 25% interest while Mobil Oil Exploration & Production Southeast Inc. (Moepsi) holds the remaining 75%. The tract is situated 10 miles southeast of Grand Isle in 65 ft of water. The partnership owns interest in 48 Gulf of Mexico platforms.

Elsewhere, Samedan Oil Corp., a subsidiary of Noble Affiliates Inc., has a gas discovery on Vermilion Block 120 located 30 miles offshore.

The discovery well, Samedan Oil Corp.'s **OCS-G 4790 Well No. 2**, was drilled in 70 ft of water to a total depth of 8,000 ft, encountering 34 ft of net gas pay in a 47-ft gross sand interval. The well tested gas at a rate of 14.1 MMcfd through a 31/64-in. choke with 2,300 psi flowing tubing pressure.

A production facility is expected to be installed later this year and gas sales are due to commence during the fourth quarter.

Ireland

Marathon intends to drill at least two wells in the Celtic Sea this year.

The company spudded the tight hole **49/13-2** late last month in 260 ft of water. The block is next to 49/9 on which Gulf/Atlantic has an oil find. After completing the well, the company intends to drill **50/3-2** for Enterprise Oil, another Maraton farm-in.

The blocks to be drilled are those on which Ardmore Exploration Ltd. negotiated a farm-in deal last year. Ardmore farmed out part of its interest to Santa Fe Minerals (Ireland) Ltd and Tuskar Resources. Marathon serves as operator during drilling.

British Gas has also spudded the first well on Irish Block 42/12 in the St. Georges Channel Basin. The well is the company's first outside the U.K. sector and is the result of a farm-in agreement last year with Shenandoah also covering blocks 42/11 and 42/7.

In a related development, the high hopes envisioned for the Irish offshore this year were dimmed somewhat recently with Chevron's decision to forego the five wildcats it expected to drill this year. The wells were to be drilled off the south coast where oil finds are the most promising since the Kinsale Head gas field.

Brazil

Despite dropping oil and gas prices, Pecten is resuming its risk contract drilling activities offshore the Santos Basin, but not in the same block where it previously found gas.

Norway

Texas Eastern subsidiary, Texas Eastern Norwegian Inc., has been awarded a 10% working interest in two Norwegian North Sea blocks. This is the company's first license award in the sector since 1979.

The award blocks are located 350 miles northeast of Block 34/4, where Texas Eastern and partners discovered the Snoore field in 1979

Additionally, the Norwegian government has asked the parliment to approve development of the Tommeliten field with a target production start-up of the summer of 1988.

South Korea

The Energy Resources Ministry has approved a joint U.S.- South Korean plan to develop the continental shelf off the country's south coast.

According to reports, the 50-50 venture calls for state-owned Korea Petroleum Development Corp. and U.S. Hadson Petroleum International to conduct a seismic survey of Block No. 5, beginning this month. The work is to be completed in 75 days. Three wildcats will be drilled on the block. The project cost is estimated at $21 million.

China

Occidental Petroleum Corp.'s Occidental Eastern Inc. unit has a significant oil discovery in the Pearl River Mouth Basin in contract area 17/15. This marks the company's first producing well in China.

The well, **Lufeng 15-1-1**, was drilled by Occidental in partnership with six other companies. Tests on two zones saw a flow rate of 2,100 b/d.

The find is the sixth in the so-called Huizhou depression.

Egypt

A consortium consisting of Total, Agip, British Petroleum and Elf Aquitaine have made a significant discovery in the deep waters off the Sinai Mediterrean coast with production estimated at 10,000 b/d.

The new Mango well, according to the Egyptian oil minister, could cost $160 million to develop. The well is located in 500 ft of water.

There are plans for further exploration in the relatively unexplored North Sinai waters. If further drilling proves the consortium has found a commercial discovery, it likely is to encourage more exploration, the government said.

British Petroleum drilled a well in an adjacent block about the same time as the Total-led discovery, but that project proved to be dry. □

THE WORLD OFFSHORE

Jim Redden
News Editor

Israel

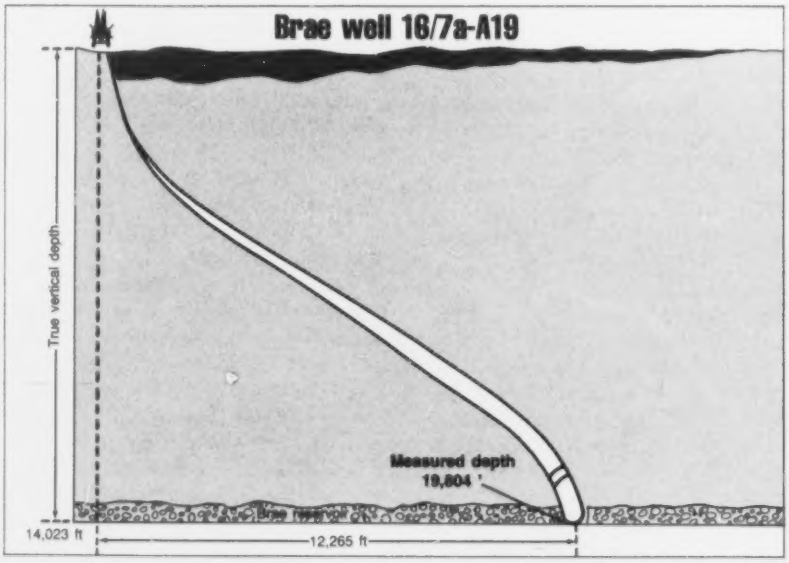
Israeli Energy Minister Moshe Shachal says the three Egyptian oil specialists who arrived in the country in late April are advising Israel on offshore oil exploration.

The assistance was requested after the Egyptians made a significant oil discovery in the Mediterranean near al-Arish.

Shachal confirmed some drilling was done opposite al-Arish when it was under Israeli control. The company drilling at that time did not reach the depth from which the Egyptians have found oil.

The Israeli government is confident oil also can be found along that nation's coastline.

"If the Egyptians found oil opposite al-Arish there is no reason why it cannot be found opposite Israel's coastline which is geographically a continuation of the Sinai coast, Shachal was recently quoted as saying.



In a related development, an unidentified U.S. oil company is planning to conduct seismic studies of Israel's Mediterrean coast sometime this summer.

While the Israeli government decline to identify the company, Shachal had met with Occidental Petroleum Co. officials in California in April. An agreement on the concession area, which will probably run from the Egyptian border along Israel's Mediterranean.

During his trip to the U.S., Shachal also met with Secretary of Energy John Herrington to discuss a variety of energy issues. During the meeting the Israeli minister proposed Israel store products for the American Sixth Fleet in Israel. Under that proposal Israel could use the stockpile in the event of an emergency.

U.K.

Marathon Oil U.K. Ltd., operator of the South Brae field, has recently has few the drilling of well **16/7a-A19** from the Brae A platform to a record measured depth of 19,804 ft.

The well, which is nearly four miles deep, is the longest well bore ever drilled in the North Sea. It reaches the eastern flank of the South Brea field and will be utilized for water injection into the Brae formation.

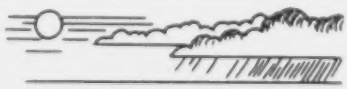
The previous longest well is believed to have been drilled by Occidental in the Claymore field to a measured depth of 18,927 ft.

Also in the U.K. sector, Hamilton Oil Corp., as operator, released test results from an exploration well drilled on Block 43/26.

Well 43/26-5 flowed gas at the rate of 40.2 MMcfd of gas on a 56/64-in. choke at a flowing tubing pressure of 2260 psi. The well is located about two miles from discovery **well 43/26-3** which was completed in December of last year and tested 49.5 MMcfd of gas.

After a lengthy delay, Britoil has released results of the U.K. Brae/Miller area **well 16/13-A-3** Palaeocene discovery.

The well was suspended as a future producer. It flowed 5,278 b/d of 38° gravity oil and 3.7 MMcfd of gas through a 50/64 in. choke. Analysts put recoverable reserves in the prospect in the 50 to 100 million bbl range with further potential to the south where a Jurassic structure was encountered in **well 16/13A-2**.



Weather Outlook

Central Gulf of Mexico

The Central Gulf in June is dominated by the Bermuda High in the North Atlantic Ocean. Winds flowing clockwise around the high are predominately from the south and southeast.

Winds are generally light with 39% being 6-16 knots with waves of two to three ft. A slight swell may persist during this month at two ft., causing maximum combined seas of five to seven ft. Average sea surface temperature is 80° F with mean air temperatures of 81° F..

This month marks the start of the hurricane season, but June normally has few hurricanes. □

Source: Institute for Storm Research

Meanwhile, falling oil prices are threatening new oil and gas developments in the U.K. North Sea. The most significant cancellation recently was the decision of Royal Dutch/Shell and Exxon to halt the more than $3 billion Gannet oil and gas development program, which industry analysts believe is the first of many to follow. Company officials say the Gannet project involved recoverable reserves of 220 million bbl of oil and was not profitable under $20 per bbl.

However, two major development projects were recently approved.

Louisiana

Michel T. Halbouty Energy Co., as operator, has completed a gas-condensate discovery offshore Lafourche Parish.

The **State Tract 12234 Well No. 1**, located in Bay Marchand, Block 4, flowed 4,213 Mcfd of gas and 82 b/d of 55° gravity condensate through a 16/64-in. choke with a flowing tubing pressure of 3,142 psi. The well was completed through perforations in Miocene sands from an interval of 8,968 ft and 9,004 ft. The well's calculated absolute open flow is 147,000 Mcfd. Shut-in tubing pressure measured 3,248 psi.

A confirmation test is planned for early commencement with additional development to follow.

Texoil Co. Inc. has discovered gas on **Main Pass Block 4** about four miles off the St. Bernard Parish coast. The discovery well was drilled in 10 ft of water to 11,350 ft.

The well flowed 3.8 MMcfd of gas from perforations between 10,269 ft and 10,294 ft on a 13/64-in. choke at a flowing tubing pressure of 3,310 psi. During a separate test, the well flowed 3 MMcfd of gas and 22 b/d of oil from perforations between 10,156 ft and 10,164 ft on a 12/64-in. choke with a flowing tubing pressure of 3,270 psi.

The operator and its partners are presently considering various development and production plans for the 1,090-acre lease.

Diamond Shamrock Exploration Co. has completed a gas discovery on a state lease. The **Main Pass Block 31 No. 1 well** flowed 5.8 MMcfd of gas and 281 bbl of condensate during testing on a 15/64-in. choke. The well was drilled to total depth of 14,915 ft. A delineation well is to be drilled this summer.

Lummus Crest Inc. of Houston has been awarded a multi-million dollar engineering contract from Conoco for a floating production platform to be located in the deepwater Green Canyon Block 184, 170 miles southwest of New Orleans.

The awarding of the contract could lead to the development of the field using the tension leg platform concept. Located in 1,750 ft of water the platform would establish a world record for deepwater production from a platform when installed in 1989 as is now proposed.

Meanwhile, Freeport-McMoRan Energy Partners Ltd. has discovered gas on Vermilion Block 28.

The **OCS-G 4784 No. 2 well** was drilled in 20 ft of water to a total depth of 18,025 ft and plugged back to 15,695 ft. The well, which encountered 80 ft of gas pay in four early Miocene reservoirs, was not flow tested. Future development wells are planned to delineate the structure.

Norway

Conoco Norway Inc., the Norwegian affiliate of Conoco Inc., has successfully completed a delineation well in the northwestern part of the Heidrun oil field.

The **Block 6507/7 No. 5 well** flowed at a maximum rate of 6,000 b/d of oil and 3.02 MMcfd of gas through two parallel 1-in. chokes. Drilled in 1,089 ft. of water to a depth of 8,646 ft. The well was tested in two intervals of Jurassic age.

After the tests were completed, the well was directionally drilled to a deeper fault block where oil was again encountered in the same sand. The Heidrum field was discovered one year ago this month.

Italy

Canada Northwest Energy Ltd. says its **Venere No. 1** well located on permit C.R103.CN off the southwest coast of Sicily has been abandoned.

The well was plugged after only minor gas shows were reported.

China

Occidental Eastern Inc., an affiliate of Occidental Petroleum Co., has discovered oil in the **Lufeng 15-1-1 well** in South China Sea 28/23 contract area.

Initial tests of two zones flowed at a combined rate of 2,100 b/d of 34° gravity oil. Results of testing in the third zone are not available.

Dr. Armand Hammer, chairman and chief executive officer of Occidental, said as a result of the Chinese National Oil Co.'s flexible energy policy, "Occidental and its partners were able to incorporate a very prospective block in the 28/23 contract area earlier this year and make the discovery."

Vietnam

Le Quoc Taun of Petrovietnam says the joint Soviet-Vietnamese venture has found commercial quantities of oil south of Vung Tau.

He added the nation was negotiating with foreign oil corporations, but the drop in the price of crude has reduced interest. Petrofina has temporarily suspended negotiations for exploration off Da Nang on the east coast. Both sides are reportedly reworking their calculations.

India

State-owned ONGC has spudded its **well Thavur-1** in the Cauvery Basin to a depth of 3,500 meters using a Soviet-built rig.

The company also has completed another well **Kovilkalappal-3** at a targeted depth of 1,900 meters. No results of testing haves been made available.

Additionally, another well, **Narimanam-1**, also in the Cauvery Basin, has flowed at a rate of 300 b/d through the early production system launched in February.

Japan-South Korea

A Japanese-South Korean consortium has resumed drilling on **Tract No. 5**, located on the continental shelf dividing the two countries.

The team, with Nippon Oil as operator, will drill a wildcat at a depth of 3,400 meters. It will be the sixth exploratory well drilled in the region.

THE WORLD OFFSHORE

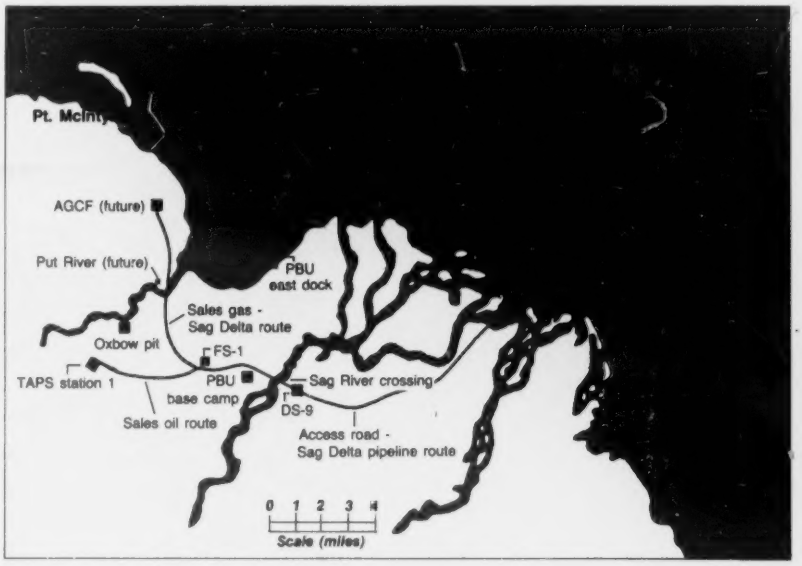
Jim Redden
News Editor

Alaska

An estimated 3,400 tons of production equipment and modules are enroute from Louisiana to the north slope of Alaska, where they will be part of the first offshore oil production in the U.S. Beaufort Sea.

The modules and equipment are being transported on a barge from the Port of Iberia, La., through the Panama Canal to the Pacific Ocean and up the U.S. West Coast. They comprise Standard Oil Production Co.'s first of two sealifts in the ongoing $1.4 billion development of the Endicott field.

Located two miles from Sag River and 10 miles northeast of the giant Prudhoe Bay field, Endicott is expected to begin production by December 1987. It is expected to reach peak production of 100,000 b/d in 1988.



Estimated to contain 350 million bbl of recoverable oil, the Endicott field is operated by Standard Oil, which holds a 56.8% interest. The company's share of the total development cost is about $780 million.

The field, situated in 7 ft of water, is believed to hold 1 billion bbl of oil in place and 1.5 tcf of gas. According to Standard Oil, the production facilities consist of two gravel islands. The program includes a main production island and a satellite production island, each containing 50 wells.

The oil is expected to be transported to shore through a pipeline that will connect to Pump Station 1 of the trans-Alaska pipeline.

Work on the production equipment and modules began at the Port of Iberia last summer. Work is underway for the final sealift of equipment, which is tentatively planned to leave the port in May, 1987.

The largest single unit shipped in the first sealift was a 2,000-ton utility module, and a life-support system that will provide the power, water and waste treatment necessary to sustain life in the Arctic.

Standard Oil's partners in the project are Exxon Corp., 21.02%; Unocal Corp., 10.52%; Amoco, 10.49%; Cook Inlet Region Inc., 0.65%; NANA Regional Corp. Inc., 0.39%; Doyon Ltd., 0.13%; and Arco Alaska Inc., 0.02%.

Elsewhere in Alaska, Marathon Oil Co. last month began installation of the Steelhead platform in Cook Inlet.

Marathon and Union Oil of California jointly own the platform to be installed in 183 ft of water in Trading Bay, about a mile southeast of the Grayling platform. The platform will develop the Grayling gas sands in the McArthur River field and will also be used to expand development of the "G" and West Foreland oil reservoirs.

Marathon projects installation will be completed by mid-September and hook-up should be finished by late this year. Initial gas production is expected in early 1987.

The 48-slot platform is the four-legged, clustered pile, tower-type structure typically used in Cook Inlet with an integral module support frame. The jacket weighs 6,400 tons and will support a topsides operating load of more than 20,000 tons consisting of 20 modules. The production facilities will handle up to 160 MMcfd of gas and 15,000 b/d of oil.

Weather Outlook

Southern Peru

The southern coast of Peru has an intriguing climate, especially in July. This region is situated between 15° South and 20° South on the western coast of South America. Along the coast, the current and wind travel northward from the colder southern regions. Therefore, water and air temperatures remain at 68° F.

The cold water currents provide a smooth path for winds to travel northward. As this occurs, water condenses above the cold air at 1,500 to 2,000 ft producing cloudy skies.

Southerly winds range from 7 to 22 knots during 75% of the time with only 6% of the winds exceed 22 knots. Seas average 6 ft and rarely reach 10 ft. An extreme cold front will produce the 100 year storm along the coast during the South American winter months. Winds may exceed 40 knots with significant waves of 23 ft. □

Source: Institute for Storm Research

Louisiana

Diamond Shamrock Exploration Co. has completed a gas discovery on an offshore state lease.

The **Main Pass Block 31 No. 1 well** flowed 5.8 MMcfd of gas and 281 b/d of 42° gravity condensate during production testing on a 15/64-in. choke with 5,658 psi of flowing tubing pressure. Drilled to a total depth of 14,915 ft, the well was perforated for testing of a Miocene sand between 11,603 ft and 11,611 and 11,626 and 11,630 ft.

A delineation well is being drilled to further determine the reserve potential and evaluate a shallower oil zone which was encountered in the well, but not tested, explained Steven Crowell, vice president of offshore exploration and development.

Diamond Shamrock Offshore Partners Limited Partnership also reports gas sales have resumed from the **West Cameron Block 648** platform following repair work on wells damaged by a fire last December.

Production from the platform has reached 35 MMcfd from six wells which have been reworked since the blowout. Additional repairs are still required for the damaged portions of the deck section on the platform.

All repairs are expected to be completed by the end of this year and gross production capacity of the platform is expected to be 85 MMcfd from 11 wells.

The A-1 well on the platform blew out during workover operations and the fire that ignited four days later destroyed the workover rig and drilling quarters. The fire was extinguished and the well capped on Jan. 22. The well has since been plugged and abandoned.

In other developments, tests by Conoco of an exploratory well indicates a new pay discovery as well as an extension to reservoirs discovered last year on Green Canyon Block 228.

The **Block 228 well No. 2** flowed at a combined maximum rate of 1,760 b/d of 35° to 38° gravity oil and 3.1 MMcfd of natural gas. The tests were made through a 8/64-in. to 16/64-in. adjustable choke. Two intervals were tested between 6,700 ft and 7,900 ft, and indications were that higher production rates would be likely under development conditions.

Further delineation wells will be drilled on the block to determine the commerciality of the discovery.

The No. 2 well is about 170 miles southwest of New Orleans in 1,694 ft of water. The location is three miles south of the Block 184 site where Conoco is developing plans to install a tension leg platform.

U.K.

Ranger Oil Ltd. of Calgary has successfully tested its **3/30-A-3 well**, northwest of the Frigg gas field.

The well tested 34 MMcfd of gas from a single pay zone through a 56/64-in. choke. Further appraisal drilling and seismic work is expected to be undertaken to fully assess the potential of the find.

Norway

Twenty Norwegian and foreign oil companies are interested in random testing of the three Barents Sea areas selected by the government to be included in the last round of leasing concessions, according to the Ministry of Petroleum and Energy.

Norwegian companies Norsk Hydro and Statoil have expressed an eagerness to start drilling as soon as possible, while the overseas companies have raised objections, including tight budgets and lack of time, the ministry says.

The companies have agreed random testing should be undertaken north of Bjornoya South and in two areas northeast of Troms I, off the northern Norwegian coast.

The tentative schedule calls for the blocks to be announced this fall and allocated by January 1987 so drilling can begin next summer.

Ireland

British Gas reportedly has encouraging results from **well 42/12-1** in a relatively unexplored area off the nation's east coast.

The well was plugged after being drilled to a total depth of 9,265 ft by Western Apollo 1. The company is presently studying the results with a view to future exploration plans on a license area covering blocks 42/7, 42/11 and 42/12.

Australia

Bond Petroleum has re-opened tenders for its offshore lease, **WA 199T**, northeast of Jabiru.

Three companies, according to a Bond spokesman, have been asked to re-submit another round of bids. The possibility remains that the Bond lease may be the only new offshore contract to be let in Australian waters this year as the industry faces major cutbacks.

China

The first oilfield in the Nanhai region, the **Weizhou 10-3** structure in Beibuwan, should start production by Aug. 1.

According to the official news agency, the timetable will be met, despite the difficulties experienced by operator Total Chine following a blowout at its development well **Weizhou 10-3-6** in January. Trial production is scheduled to begin later this month.

Alabama

Shell Offshore Inc. and Amoco Production Co. have jointly made a significant gas find in state waters south of Mobile Bay.

The wildcat on **State Block 113** flowed up to 15 MMcfd of gas from the deep Norphlet formation. The exploratory well was spudded in April and was tested after reaching total depth of 22,390 ft.

The potentially major find is located four miles southeast of Dauphin Island and just south of the prolific Mary Ann.

Block 113 is a 5,123-acre tract purchased by the two companies for $34.37 million.

India

A special cell is being formed in the Union Ministry of Petroleum and Natural Gas to deal with all inquiries relating to offshore tracks included in the third round of leasing, according to Minister Chandrashekhar Singh.

The special cell is designed to quickly provide information, advice or clarification to foreign oil companies participating in the leasing round. The offshore acreage is expected to be awarded by next December.

Additionally, a flow rate of 3,413 b/d of oil has been recorded in a well drilled about 50 km south east of the South Tapti gas field. The well was tested through a 1-in. choke after being drilled to a total depth of 2,750 meters. □

THE WORLD OFFSHORE

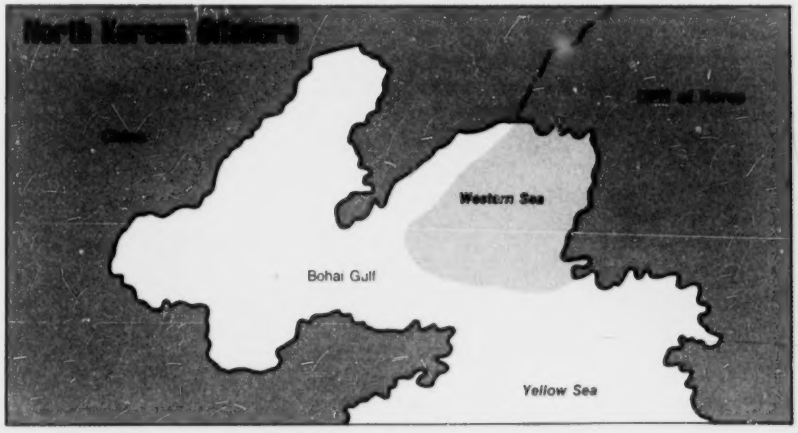
Jim Redden
News Editor

North Korea

North Korea is reportedly interested in soliciting foreign assistance for exploration activities in the Western Sea east of Bohai.

A North Korean delegation made its first appearance at the Offshore South East Asia conference in Singapore. The delegation was on a shopping spree for drilling equipment for its offshore program, which one delegate was quoted as saying, "will be positive and will bring good results in the near future."

Norwegian and Yugoslavian companies have undertaken seismic activity in the nation and may conduct more in the future, the North Korean delegation indicated. Sources in Japan indicated the most promising area for exploration within the boundaries of North Korea is the so-called Western Sea.



No details were made available, but some exploration activity was reportedly undertaken last year.

U.K.

Conoco (U.K.) Ltd. announced successful test results from an appraisal well about 70 miles east of the Shetland Islands.

The **Block 3/2 No. 8 well** flowed at a rate of 7,340 b/d of 34.2° gravity crude through a 7/16-in. choke from Jurassic Brent Sandstone. Drilled to 13,550 ft in 536 ft of water, the well was an appraisal of an oil discovery made in 1976 on Block 3/7a, which is operated by Chevron Corp. The company has no immediate plans for further drilling.

Mobil's wildcat discovery **9/13b-28a** located west of the Beryl A platform, could by the 1990s become part of a satellite complex around the company's Beryl field. The well was spudded in February and temporarily suspended on May 20. It tested 6,700 b/d of 37.6° gravity crude through a 48/64-in. choke with gas flow at 3,400 Mcfd.

One industry analyst said it is unlikely the reserves will be developed now, but estimates indicate by 1990 Beryl will reach peak production of 125,000 b/d falling to 88,000 b/d by 1993 and 20,000 b/d by 2003. From the early 1990s, the dwindling reserve level could be filled by new reserves linked as satellites to the existing infrastructure of the field. Although Mobil has no immediate plans, industry sources expect subsea development by the 1990s.

Development plans for gas fields on **Blocks 48/18b and 48/19b,** where Lasmo has a 31.25% share, will be ready by the end of the year, says Lasmo. The development timing will depend on British Gas Corp.'s purchasing schedule. The field contains an estimated 350 MMcfd and flow rates were 29,000 Mcfd at last appraisal. Additionally, a discovery well has been completed by Lasmo on Block 3/30 just north of Frigg and tested at 34,000 MMcfd on a 3/4-in. choke.

Alabama

Tests of a well operated by Standard Oil Production Co. has resulted in another significant natural gas discovery in Mobile Bay federal waters offshore Alabama.

The discovery on **Mobile Block 821,** which is located in 49 ft of water about 37 miles south-southeast of Mobile, Ala., tested 23 MMcfd of gas through a 25/64-in. choke from perforations below 21,754 ft in the Jurassic Norphlet formation. The wildcat was spudded in October 1985.

The block that was acquired for $3 million during federal OCS Sale 67 in February 1982.

Weather Outlook

Western India

During August, west and southwest winds occur in the Arabian Sea off the west coast of India. The winds average 86% from those directions and 10% from the northwest. Wind speeds of 11-21 knots occur 56% of the time, while 10% of the winds are greater than 22 knots. The waves for this area are 12 ft or higher 7% of the time. This means that there is some swell from the west that causes the Maximum Combined Sea to be high when winds are moderate.

Tropical cyclones affect the Arabian Sea with two cyclone seasons. One occurs April, May, and June with a lull in July, August, and September. Another tropical cyclone season becomes active in October, November, and December. □

Source: Institute for Storm Research

Louisiana

Amoco Production Co. has an oil and gas discovery on **West Delta Block 75** in 170 ft of water.

The well tested 1,042 b/d of oil and 238 Mcfd of gas through a 8/64-in. choke at a flowing tubing pressure of 7,600 psi. The well was tested between 17,630 ft and 17,680 ft.

A further test between 17,630 ft and 17,680 ft flowed 125 b/d of oil and 5 MMcfd through a 10/64-in. choke with a flowing tubing pressure of 10,250 psi. Amoco holds a 100% working interest in the block.

Howell Corp. has begun natural gas sales from its **Main Pass Block 64** platform in the Gulf of Mexico.

Initial sales of 10.2 MMcfd to SNG Trading, a unit of Sonat Inc., calls for a price of $1.70 per Mcf.

California

The U.S. Environmental Protection Agency has proposed issuance of a national pollutant discharge elimination system permit to Exxon U.S.A., which would authorize discharges associated with six wildcats the company proposes to drill offshore southern California.

The wells would be located near Santa Barbara, 15 miles south of Point Mugu. The permit, which would apply to OCS leases **P-0528, P-0529** and **P-0530,** would authorize discharge of drilling muds, drill cuttings and other wastes.

The requested permit expiration date is April 1991.

Ireland

Marathon Petroleum Ireland Ltd. has plugged and abandoned its **49/13-2** well in the Celtic Sea after reaching total depth of 5,274 ft.

Shows of oil and gas were encountered and a drillstem test recovered some hydrocarbons. Plans for possible future exploration of the block will depend on further evaluation of the results of the well and additional review of other geological and geophysical data.

Meanwhile, the Irish offshore sector has suffered another setback with the decison of British Petroleum to postpone its drilling program. BP's decision comes on the heels of the withdrawal of Chevron/Gulf and Total deciding to hold off on drilling its **57/7-2 well** planned this year. BP will drill late this year at the earliest and another well planned for 1986 may be abandoned entirely.

Africa

Agip started an offshore drilling and production project in Brass, Rivers state in Nigeria.

Anticipated cost is $420 million for the project, which will include 16 wells. Construction of the production platform is expected to take two years. The field is expected to produce 35,000 b/d of oil for 10 years.

The company also has signed a service agreement with the Nigerian National Petroleum Corp. to reduce rising costs and improve efficiency.

Saga Petroleum is willing to resume operator responsibility for the Seme oilfield in Benin.

Pan Ocean, the operator who took over for Saga last year, has pulled out and the Norwegian treasury has a claim on Benin of an estimated $80 million while Saga risks a loss of $5 million. Saga said it will not consider further investments in Benin, but would be willing to resume operatorship providing its costs are covered and a reasonable profit realized.

Indonesia

Indonesian President Suharto inaugurated Marathon's **Kakap Block KH** field last month.

The field, which is located 300 km northeast of the Great Natuna Island and about 1,250 km north of Jakarta, has been under trial production since March and is producing about 7,000 b/d of oil, while its peak production capacity is expected to be 22,000 b/d of mostly waxy 46° gravity crude. A total of 24 wells have been drilled over nine years in the field.

Australia

Bond Petroleum has re-opened tenders for its **WA 199T** lease northeast of Jabiru with three companies being asked to re-submit bids.

The Bond lease may be the only new offshore contract to be let in Australian waters this year.

Canada

W.H. Hopper, chairman of Petro-Canada, says development of the giant Hibernia field offshore Newfoundland "is not going to fly under any normal fiscal regime."

Addressing the House of Commons Energy Committee, Hooper said the government must be prepared to cover more of the development cost.

He said the Hibernian partners and the federal and Newfoundland governments will settle on a fiscal support package that will include loan guarantees and possible price guarantees. A final decision on proceeding with Hibernia should be made at year-end at the latest.

Spain

Oxy has abandoned its exploration activity in Spain, making Hispanoil the operator in the permits **Vizcaya A** and **Santander C.** The consortium now consists of Hispanoil, Hadson, Marinex, CNWL and Great Western.

China

Total is expected to begin production this month at the **Southwest Weizhou 10-3 field** in the Beibu Gulf. The field is expected to be the first to be produced in the South China Sea.

The operator has already installed a 30,000 b/d capacity production platform and other facilities, including a 175,000 dwt tanker to serve as a floating process, offloading and storage unit. Production is expected to be around 20,000 b/d.

In a related development, China has prepared a program under which China National Offshore Oil Corp. and China Natural Gas Utilization Corp. will spend $1 billion in developing the Yinggehai offshore gas field in the South China Sea.

Of this amount, $800 million will be spent on laying the 1,052-km pipeline to connect the field with Guangdong Province. The Qiong-Shen pipeline will carry the Yinggehai gas from Nanshan on the southern tip of Hainan Island to the Shenzhen Special Economic Zone near Hong Kong. Construction will begin in October 1987 and will take 22 months to complete. Delivery of the gas will begin in July 1989.

Meanwhile, preliminary results from tests being conducted on Arco's fourth delineation well in the Yinggehai gas field show an unsually high gas flow, but a sizable quantity of H_2S also has been identified in the **Yachene 13-1-4 well.** □

THE WORLD OFFSHORE

Jim Redden
News Editor

Australia

Chaos in today's petroleum market and diminishing output from the nation's prolific Bass Strait region are forcing Australian operators to look towards relatively inexpensive marginal fields.

According to Det Norske Veritas, a certifying authority for Australia's offshore operators, operators now concentrate on smaller fields. One example cited by the authority was the Bream field with a potential of 35 million bbl as compared to the 1,000 million bbl capacity of the Kingfish field.

Operators look at such lower-cost production schemes as mini- or satellite platforms and subsea completions. Australian analysts estimate the use of subsea completions will be feasible for reserves of 8 to 10 million bbl.

Despite a gloomy forecast for the remainder of this year, Australia has no intention of lowering its production. The nation is presently, according to DNV, exporting about 100,000 b/d, which is the largest single source of revenue for government coffers. The policy at this time "is to maximize production and thus maximize excise duty," according to Det Norske Veritas.

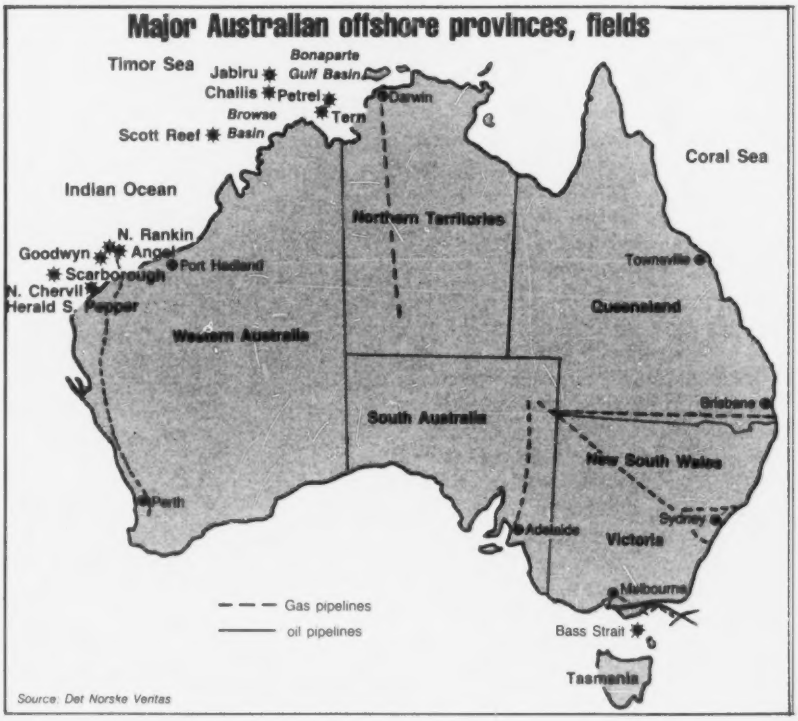
Exploration prospects, however, appear slim off the nation's continental coast for the remainder of this year. The Australian Petroleum Exploration Association recently said the 57% cut in domestic crude prices means more than 120 wells planned this year will not be drilled. The study shows a 22% fall in offshore exploration drilling planned for the remainder of 1986.

Any exploration activity that occurs offshore Australia in the foreseeable future will shift from Bass Strait in the south to the northwest continental shelf. The region extends from Barrow Island off west Australia to Melville Island in the Northern Territory.

The discovery of the North Rankin, Angel, Scott Reef and Goodwyn fields spurred activity in that region in the early 1970's and has been the site of extensive exploration since. By 1993 another platform is expected to enter service on the Goodwyn field, southwest of the Rankin A platform, according to Det Norske Veritas. A third platform, or possibly a subsea completion unit, also will be installed on the Rankin complex before the end of the decade.

Production also is expected to begin later this year on British Petroleum's holdings in the Timor Sea. The operator estimates production of 13,000 b/d from the Jabiru complex through a subsea completion.

Hadson Petroleum International Ltd. of Oklahoma City, Oklahoma also has been awarded the right to drill a permit in the Timor Sea. The company has been granted the Ashmore and Cartier Islands permit AC7/85, which is south of the Jabiru



Weather outlook

Bay of Campeche

The September climate in the Bay of Campeche is hot and humid and the east wind blows at 8 to 12 knots during most of the day. The waves average two to four feet and an occasional thunderstorm is experienced and can raise the winds up to 25 to 40 knots and lower the temperature around 10° F.

The area experiences a tropical storm about every three years. The storm either forms in the area or passes into the area over the Yucatan Peninsula. A storm is expected to form in the area every six years. □

Source: Institute for Storm Research

oil discovery. The company plans to drill at least four wildcats along with the undertaking of extensive seismic surveying.

In a related development regarding the Jabiru field, a purported one-of-a-kind mooring riser has been launched at Port Adelaide, South Australia. The 700-ton riser was built by Eglo Engineering and is destined for installation on the Jabiru field.

The riser will permit BHP and its partners to produce marginal oil deposits in a pressure vessel similar in construction to a submarine hull. The free floating riser will be anchored to the seabed and the oil pumped through four production lines to a moored tanker. A coupler can be quickly disconnected in case of a storm or other emergency.

Norway

Statoil has completed a test on **well 30/6-19** on Oseberg Block 30/6.

The well was drilled to a total depth of 10,830 ft. and tested Middle Jurassic Brent sands at a maximum flow rate of 8,165 b/d of oil and 2.3 MMcfd of gas on a 60/64-in. choke. Two additional tests of the Brent sands flowed at rates of 5,590 b/d of oil and 3,113 b/d with no water observed in any of the tests.

The well tested an oil column of approximately 340 ft, which was 160 ft thicker than seen in the **30/6-5** well in an adjacent fault block.

According to the operator, the well, which was temporarily plugged and abandoned, will undergo extended production tests at a later date.

Soviet Union

The Barents Sea exploration program fell far short of government goals during the 1981-85 period and continues to lag badly.

According to reports, the Arctic Offshore Oil and Gas Exploration Trust carried out only 46% of its assigned work over the past five years. Furthermore, wildcat drilling in the Barents Sea also did not meet its target during the first five months of this year.

The main reason cited for the poor exploration performance is bad planning and organization, along with failure to make efficient use of the area's mobile rig drilling capacity, says the Moscow newspaper "Socialist Industry."

"Strict reprimands," the paper noted, has been issued to the manager, chief engineer and chief geologist of the trust and to the head of the Arctic Offshore Exploration Drilling Administration.

Two drillships and a jackup built in Finland and a Soviet-built semisubmersible are presently operating in the sea. Reports of difficulties caused by Soviet inexperience with Arctic class drillships appeared earlier in the western press, but not in the USSR.

Exemplifying Soviet woes is the jackup Baky, which was the first in a series of Kaspii class rigs built at Astrakan for the Caspian. Commissioned in 1975, the rig has been in service for 11 years but has drilled only 131,232 ft of hole and completed just seven wildcats.

The government now plans to double exploratory drilling in 1986-1990 as compared to 1981 through 1985. The increased activity is expected to be undertaken in the Caspian Sea, but also will be stepped up in the Black Sea and the adjacent Sea of Azov, in the Baltic and Barents Sea and in the Sea of Okhotsk.

Texas

Amoco Production Co. confirms a significant gas discovery extending across Matagorda Island Blocks 519 and 487 in the Gulf of Mexico.

The confirmation well, **Matagorda Island Block 487 No. 2,** encountered 130 ft of net natural gas pay at 14,800 ft in lower Miocene sands. The tracts are located in 69 ft of water about 10 miles offshore.

The original discovery well, **Matagorda Island 519 No. 1**, flowed 24.9 MMcfd of gas.

Meanwhile, Seagull Energy Corp.'s, Seagull Shoreline Systems, has begun gas deliveries from Matagorda Island Block 622.

The company's added volumns, which represent initial production from Amoco Gas Co.'s interest in block 622 reserves, have increased the transmission company's output to 200 MMcfd. Since placed into service two years ago, Seagull Shoreline has averaged a throughput of 75 to 80 MMcfd.

"The first deliveries from Block 622 represent the beginning of a new phase in our development. With these new volumes and the possibility of additional future througput, we expect to expand the capacity of our 52-mile first phase to more than 400 MMcfd in the near future," says Seagull Chairman Barry J. Galt.

Egypt

Texaco International (East Gharib Egypt) Inc., as operator, has tested a flow of crude oil in the Gulf of Suez.

Exploratory well **EG-J1** is situated in the East Gharib contract area, a nearly 80,000-acre block operated under a production sharing contract with Egyptian General Petroleum.

The EG-J1 tested at a combined rate of 5,520 b/d of 37.9° gravity crude from multiple intervals through a 48/64-in. choke. The well was drilled to a total depth of 12,300 ft in 178 ft of water.

Indonesia

Hudbay Oil (Malacca Strait) Ltd. discovered oil offshore Sumatra in the Malacca Strait, says Pertamina.

Discovery well **MSGB-1** flowed at the rate of 8,450 b/d of 41° gravity crude from depths between 1,384 to 1,540 meters through a ½-in. choke from five zones.

Hudbay, which already exports about 32,000 b/d of Lalang oil from its adjacent Lalang block in the Straits, expects to start production from the new well site in December. The contract area also includes the Mengkapan and Melibur fields.

U.K.

Mobil North Sea Ltd. has made a discovery in Block 49/29b in the southern gas basin. It marked the third offshore discovery for the company of the summer.

The wildcat **49/29b-4** was drilled in 122 ft of water to a total depth of 8,400 ft. On a test, the well flowed at a maximum stabilized rate of 31 MMcfd of gas through a 52/64-in. choke.

This latest discovery follows an earlier announcement of a recent Mobil oil find in Block 9/13b, 210 miles northeast of Aberdeen, and a gas discovery in Block 48/17a in the southern gas basin. Well **9/13b-28a** flowed at a stabilized rate of 6,208 b/d and 3.4 MMcfd of gas through a 48/64-in. choke. Well **48/17a-2** tested up to 34 MMcfd of gas and 652 b/d of condensate on a 56/64-in. choke. □

THE WORLD OFFSHORE

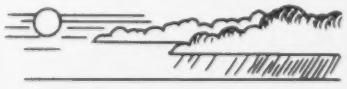
Jim Redden
News Editor

Brazil

While the majority of players in the global petroleum sector continue to languish in an economic crisis, activity offshore Brazil gives the impression of a nation in the middle of a boom.

State oil company Petrobras, already the leader in deepwater exploration and production, says it will spend millions of dollars in the near term to exploit its offshore reserves. Brazil's massive Campos Basin has been the site of world class deepwater oil discoveries, which have somewhat overshadowed the enormous natural gas reserves lying under the seabed.

In the first half of this year, Petrobras removed an average of 15.5 million cu meters, which was 4% more than that produced during a like period last year. That total promises to rise considerably with the recent delineation of a gas well off the northern sector of the nation, which holds recoverable reserves estimated at 3.7 billion cu meters, Petrobras says.



Weather Outlook

Southern Brazil

The winds off southern Brazil in October are usually from the northeast or east and have a 40% to 50% chance of being less than 10 knots and a 32% frequency of 17 knots or higher. The mean air temperature is 20°C.

There normally is a 90% frequency of visibilities of greater than 5 nautical miles. Most of the waves are between 5 and 8 ft.

One also should be aware of the squall line that results in winds from the southwest of 50 knots and waves of 8 to 12 ft. These squall lines last from 10 to 20 minutes. □

Source: Institute for Storm Reasearch

With the testing results of the Pescada field, Brazilian gas reserves have topped 92.7 billion cu meters. Petrobras says no estimates are available for the amount of condensate and light crude also trapped in the Pescada field.

Brazil earlier announced an aggressive exploration and development program for its offshore discoveries. As part of that program, the state-owned explorer says it will spend $123 million to expand its gas pipeline system in the Campos Basin.

A main subsea line is being designed to connect the Enchova field with Macae, while another will link the Enchova with the Garoupa field. The offshore pipeline system is expected to cost about $75 million. The remainder of the expenditure will go towards extending the nation's onshore system.

When the new pipeline network is in operation by 1989, an estimated 7.5 million cu meters/day will be transported to the refinery at Duque do Caxias near Rio de Janeiro.

Despite the chaotic situation with world oil prices, Brazil shows no intention of lessening its activities. Petrobras President Helio Beltrao publicly says he does not believe the falling international oil prices "should be used as a reason for cutting down on Brazil's oil exploration and production program."

"It would be extremely imprudent to change our medium and long range policy, just because the prices of oil started dropping," he said.

Petrobras, meanwhile, has released the test results from the Campos Basin discovery well **RJS-345** located offshore Cape Sao Tome and adjacent to the Corvina field.

The well, Petrobras said, tested 2,200 b/d of 29° gravity crude. It is located in 911 ft of water and contains reserves estimated at 44 million bbl. The well is expected to enter the production mode in short order, the company said.

The Campos Basin has 24 named fields and a number of smaller accumulations and has estimated reserves of 1.2 billion bbl. That number excludes the deepwater Marlin and Albacora fields.

Denmark

Amoco has reportedly discovered oil in Block 5504/1-2 in the central basin of the Danish North Sea.

The well is located near the prolific Gorm field and is the first discovery reported from the first exploration round held in 1984. The well is on blocks returned to the state by the Danish Underground Consortium.

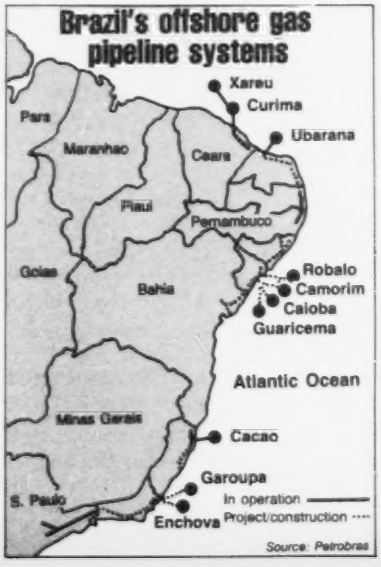
Tight hole status has been applied to the well.

Texas

Union Exploration Partners, Ltd. has begun production from the partnership's Cerveza Ligera platform in the Gulf of Mexico with initial production of 2,500 b/d.

Cerveza Ligera is located on East Breaks Block 159 in 925 ft of water. The structure is used to develop the Plio-Pleistocene oil and gas reserves under East Breaks blocks 158 and 159, located southeast of Galveston.

Production by early next year will increase to about 11,000 b/d when



output begins from the Cerveza platform, which is being used to develop the reserves under East Breaks blocks 160 and 161. That platform also is operated by Union Exploration Partners.

With both platforms on production, the field's total gas availability will be approximately 70 MMcfd.

Alabama

Conoco last month spudded what promises to be the second deepest well ever drilled in the Gulf.

The company's 24,200-ft. test in Mobil Area OCS block 991 is an attempt to further extend the prolific Norphlet formation to the south and west. Chiles Drilling Co.'s jack-up Yucatan will sink the well that requires a 1.3 million lb. hookload to accomodate the 10¾ by 9⅞-in. tapered casing string.

Tenneco drilled, but did not test, the deepest well in the Gulf with its 25,000-ft. Viosca Knoll block 117 wildcat. Chevron proved the Norphlet extended to the west with its 21,645-ft. wildcat on block 861.

The Conoco well is expected to incur abnormally high pressures with a high H_2S content.

Canada

Three major operators, falling victim to low international oil prices, have pulled up stakes in the Beaufort Sea.

Gulf Canada Corp., Dome Petroleum Ltd. and Imperial Oil Ltd. says they are temporarily closing up shop in the Beaufort.

Earlier this year, Gulf Canada officials were ecstatic over the giant Amauligak discovery in the Beaufort, which holds reserves estimated at 700 to 800 million bbl. The latest well drilled on the structure tested at 16,000 b/d, which is believed to be the highest flow rates ever recorded in Canada. Despite the success story, Gulf says it can no longer continue exploration in the capital-int ·nsive Beaufort until prices begin rising.

Imperial Oil will be completing two more scheduled offshore wells this winter and then plans on closing its Tuktoyaktuk base. No further exploration is planned.

Dome Petroleum, meanwhile, has two rigs working in the U.S. Beaufort Sea, but has no plans for any Canadian Beaufort activity.

Abu Dhabi

Japan's United Petroleum Development Co. Ltd. says it will begin oil production late next year at the Arab-C zone of **al-Bundug field**, which lies in both the Abu Dhabi and Qatar continental shelves.

The field is expected to produce 7,000 b/d through the drilling of two production wells and four water injection holes.

U.K.

Despite the worldwide cutback in new oil projects, 10 oil and gas developments have been approved this year for the North Sea's U.K. sector.

In addition to approving the 10 projects this year, the minister of energy also hopes to give the go-ahead to two gas developments before the end of 1986.

"The U.K. needs to replace some current gas supplies by the mid-1990's, so there are strong incentives to explore for gas on the U.K. continental shelf," says Alick Buchanan-Smith, U.K. energy minsiter.

Britoil recently received the blessing of the energy minister to develop a separate Thistle reservoir.

The so-called Thistle Area 6 will see production in the reservoir rise to a peak of 2,500 b/d.

Fina Exploration is drilling ahead on **wildcat UK 9/17b-4**.

Angola

Mitsubishi Petroleum Development Co., Indonesia Petroleum Ltd. and Taiyo Oil Co. have established a joint venture to participate in exploration offshore Angola.

The three Japanese companies have formed Ajoco Exploration Co. Ltd. with an initial capital outlay of $2.5 million.

Norway

Norwegian operators are less than enthusiastic over the government's plan to reduce taxes by 15% for new offshore development projects.

Operators claim the tax relief package does not go far enough. They went on to say the reduction would do little to help the beleaguered Troll-Sleipner gas project which will cost an estimated $8 billion to develop.

Malaysia

At least three companies are seeking additional offshore acreage to expand their Malaysian operations.

The companies, Esso Production Malaysia, Sabah Shell Petroleum and Sarawak Shell, have submitted proposals which are under examination by Malaysia officials.

India

The state-owned ONGC has discovered oil in its **Kaikalur-3 well** in the Krishna-Godavari Basin. The well tested at a flow rate of 200 b/d of light oil through a ½-in. choke.

While only a marginal find, Indian officials say the discovery increases the possibility of large commercial finds in the basin.

South Africa

The production life of the Mossel Bay gas field will be substantially longer than the earlier estimate of 30 years, according to the state oil and gas exploration company Soekor.

As per South African law, no reserve or production figures are available. However, some sources have said gas finds near the field total about 1 trillion cu ft.

Australia

The takeover of the North Rankin gas platform by 330 disgruntled workers has damaged Australia's international business credibility and threatened future business projects, Woodside Offshore Petroleum charges.

In a full-page advertisement in the newspaper ***The Australian***, company officials claim the workers' actions "have captured worldwide attention and raised grave questions about Australia's business credibility."

The workers seized control of the platform on the Northwest Shelf after they were fired by the operator, who claimed they were organizing a work stoppage and leaving the platform in a dangerous situation. The workers denied helicopter and police access to the rig for three days.

Woodside officials say lenders involved in the Rankin project expressed concern over the incident. □

THE WORLD OFFSHORE

Jim Redden
News Editor

Australia

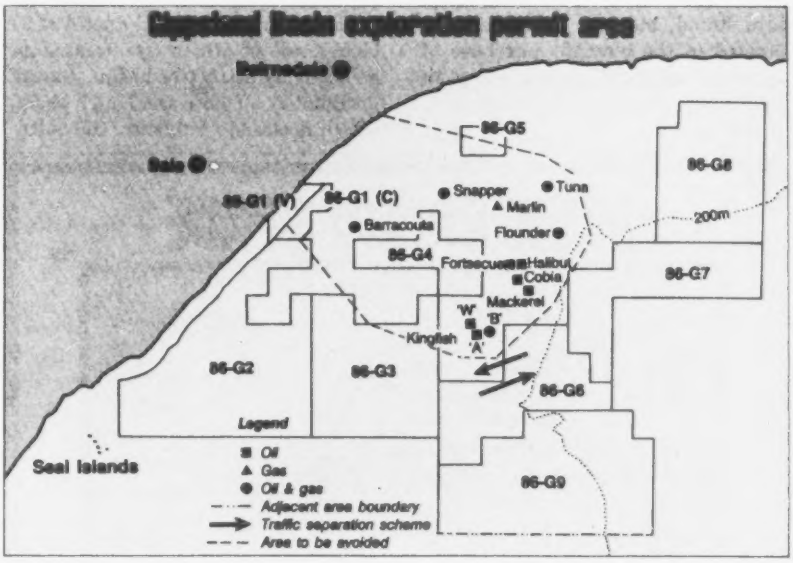
Applications are being accepted for promising exploration acreage in the Gippsland Basin off the Victorian coast.

This marks the first release of acreage in the Gippsland Basin since 1981.

"Given the proximity of the acreage to the petroleum production facilities in the basin, it is expected there will be considerable interest shown in these areas," says a spokesman for the minister of resources and energy. "Several companies have already expressed possible interest in the acreage notwithstanding the current climate in the industry."

Ten areas in the vicinity of Bass Strait producing fields are being released.

Areas 86-G1 (V) and 86-G1 (C) are being released under section 23 of the Petroleum (Submerged Lands) Acts of the Commonwealth and Victoria. This release marks the first time in several years that this section of legislation has been used for the awarding of petroleum acreage, the spokesman said. The section was originally included in the offshore legislation of 1967 to provide a special bidding system for use in the release of acreage containing known petroleum reserves.



Section 23 provides for bids to be submitted in terms of a proposed work program combined with an amount that the applicant is prepared to pay for the award of a permit.

Applications for these areas may be lodged with the Victorian Department of Industry, Technology and Resources until Feb. 27, 1987.

Meanwhile, the nation's desire to become oil self-sufficient by the 1990s has been given a major boost by the North West Shelf Joint Venture Partners, who said the Goodwyn field is rich in condensate reserves.

Latest drilling reports have substantially increased the estimates of Goodwyn reserves to 170 million bbl and when combined with the existing producing fields of the North West Shelf, may be able to supply about 100,000 b/d of condensate when Goodwyn is brought on stream in 1993.

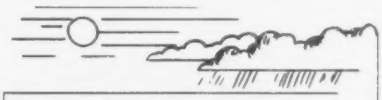
Depending on domestic demand and the development plans of the Goodwyn field, North West Shelf liquids could be supplying between 10% and 15% of the nation's petroleum demand in the 1990s, either directly or by earning export income needed to pay for oil imports.

"The substantial revision of these reserve estimates illustrates the uncertainty surrounding calculation of future self-sufficiency in petroleum and emphasizes the need for policies to be sufficiently robust to accommodate unforeseen changes in the national liquid fuels supply/demand relationship," says Sen. Gareth Evans, minister for resources and energy.

India

Despite the dismal conditions in the worldwide petroleum industry, an "encouraging response" has been received from foreign operators interested in the country's third round of bidding for offshore acreage.

As expected, Royal Dutch Shell will solicit a couple of blocks offered for exploration in the third round. The company already has purchased the data package and is attempting to



Weather Outlook

Sicily, Adriatic Sea

The Alps and the mountains of Yugoslavia to the north provide a barrier that prevents the cold fronts from the Soviet Union from sweeping across the Adriatic Sea, resulting in relatively mild weather.

Most of the winds are five to 22 knots from the northwest and gale force winds occur 5% of the time. The waves usually are four to five feet in November and the sea surface during the month averages 60°F.

When the cold air continuously piles up behind the mountains of Yugoslavia and northern Italy, it will spill down and obtain velocities of 50 to 75 knots. These strong winds are called Bora and only prevail five or 10 miles offshore so high waves are not created. □

Source: Institute for Storm Research

link its offshore interest with the Karnal refinery, which is to be established in Haryana.

Chevron Overseas Corp., which drilled three wells in Saurashtra offshore block II under the contract signed in the second round, has also bought a data package.

As of early last month, no Japanese companies showed any interest in the third round, indicating they are interested in the outright purchase of fields rather than participating in exploration ventures, a government spokesman said.

Besides Shell and Chevron, 11 additional companies have purchased basin data, including Statoil, Mobil, Standard Oil, Agip, Enterprise Oil, Peter International, Marathon, Husky Oil, Amoco, Britoil and Champlin Petroleum Co.

The third round, which was announced last January, will close this month.

The nation has offered a total of 27 blocks, all of which are located in geologically attractive basins. Except for Bombay offshore and Kutch basin, which is close to Pakistan, the entire continental shelf in the Arabian Sea has been thrown open for exploration.

All basins are being offered in the Bay of Bengal, except for a few areas in Palk Bay and the Godavari Basin, where state company ONGC has hit oil in non-commercial quantities.

The contract offer is on a production sharing basis with the contractor bearing the exploration risk. However, the government now is offering full cost recovery before production sharing.

Louisiana

Mobil Oil Exploration and Producing Southeast Inc. (Moepsi) has made an oil discovery in Garden Banks 72 about 230 miles southwest of New Orleans.

The **Garden Banks 72-1** wildcat, which was drilled in 500 ft of water, was sunk to a depth of 7,388 ft and tested at a stabilized flow rate of 3,845 b/d of oil and 2.7 MMcfd of gas through a 1-in. choke. The test was conducted between 5,752 ft and 5,830 ft in Middle Pleistocene sands.

Additional drilling will be required to determine the commerciality of the discovery, the company said.

In another development, Forest Oil Corp. claims a significant oil discovery in Eugene Island block 190.

Forest Oil says the wildcat on the block in 70 ft of water was drilled to total depth of 7,530 ft. No test figures were released.

China

Amoco Orient Petroleum Co. has signed its third contract for acreage offshore China.

Amoco's agreement with the China National Offshore Oil Corp. is for Contract Area 04/29, which covers about 1.5 million acres in the South China Sea. Amoco now holds 2.4 million acres under contract in the the South China Sea.

The contract area includes 19 blocks and is northeast of Amoco's two other contract areas in the South China Sea. The new contract area is about 200 miles east of Hong Kong in water depths ranging from 195 ft to 325 ft.

Contract Areas 29/04 and 16/34 were acquired by Amoco in January and April, respectively. Contract Area 29/04 contains 791,214 acres and Contract Area 16/34 contains 157,897 acres. Amoco's seismic acquisition program on the two contract areas was completed in June. Drilling will commence next year.

The company said seismic acquisition in Contract Area 04/29 will begin shortly with wildcat drilling planned for 1987 or 1988.

According to the agreement, Amoco will fund 100% of the exploration activity with the CNOOC having the option of participating up to 51% in the development and future production of any oil discovery.

Barents Sea

Geoscience Aberdeen has completed 2,500 sample surveys of the Loppa Ryggen East area of the Barents Sea.

This is believed to be the largest single offshore exploration geochemistry data ever obtained.

Angola

An international consortium led by Texaco Latin America/West Africa has made a new oil discovery in a wildcat off the northwest coast of Angola.

The **Cavala-1 wildcat**, located 17 miles offshore on Block 2, flowed at an average rate of 2,675 b/d of 30.9° gravity crude through a ¾-in. choke from a Cretaceous dolomite reservoir below 8,200 ft. The well was drilled to a total depth of 9,655 ft in 96 ft of water.

Cavala-1 is the consortium's latest oil discovery in the southern area of Block 2. The wildcat is situated three miles north of the Lombo East Field, which was discovered by the group in December 1983, and four miles northwest of the promising **Sulele West-1** discovery announced last November.

Further evaluation is underway to determine the development potential of the newest discovery.

Operations in Block 2 are conducted under a production-sharing agreement which was entered into with the Angloa government in 1980. Since then, the consortium has been producing in the Essungo field in the northern part of the block.

Japan

Conoco and Nippon Mining Co. Ltd. of Tokyo will join in a $135 million joint exploration venture on selected Conoco acreage in the Gulf of Mexico.

The pact is the latest in a series of international exploration agreements by Japan.

Conoco will serve as operator for the program, which calls for 20 onshore and offshore wells to be drilled in the U.S. Six of the wells are onshore and the remainder will be drilled offshore Louisiana. The program also includes leasehold acquisitions and seismic activities.

"We expect to drill the first joint well in the Gulf of Mexico's Green Canyon area," said Max Pitcher, vice president of Conoco's North American exploration operations.

Nippon Mining is opening an office in Houston as a result of the deal.

The agreement was signed by Pitcher and Takashi Sakamoto, managing director of Nippon Mining.

"We are extremely pleased that this agreement will bring economic benefit to contractors and others in a five-state area," Pitcher said.

Teikoku Oil Co. Ltd. will participate with Nippon Mining in the program while state-owned Japan National Oil Corp. is expected to participate in financing the program.

The venture is the first with a Japanese firm for the North American exploration arm of Conoco. □

THE WORLD OFFSHORE

Jim Redden
News Editor

China

The first barrel of oil has officially been lifted from the **South West Weizhou 10-3** field in the Gulf of Beibu, northwest of Hainan Island in the South China Sea.

Weizhou 10-3 is the first field offshore China to begin production.

Operated by Total Chine of Paris, the field was discovered in 1982 and is presently flowing at the rate of 10,000 b/d from four wells. According to Total, "an appraisal trial development has been designed to test over a two-year period the possibilities of recovering more oil from a highly faulted structure."

The oil is produced from a fixed multi-well platform and transferred by a 1.5 km sealine to a single-point mooring system and from there to a floating process and storage offloading facility.

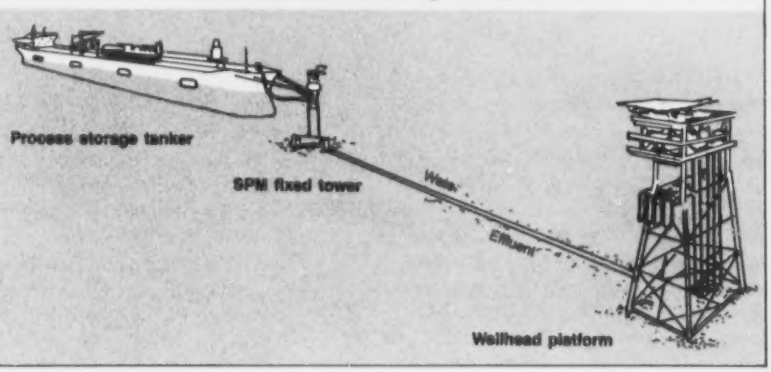
Total said the facilities have a capacity of 30,000 b/d.

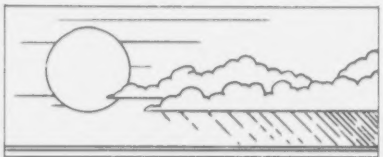
Weizhou oil is light and possesses high paraffin content, which required equipping the pipeline with thermal insulation and providing heating for the surface installations.

A water injection system also was established to improve oil recovery.

UK independent operator Cluff Oil says its well **10/36** off China found no hydrocarbons in the upper Fu Ning formation, but a core taken from the underlying Tai Zhou horizon indicated the presence of hydrocarbon source rock and traces of oil.

Weizhou 10/3 development scheme





Weather Outlook
NW Australia

The winds offshore the northwest Australia coast are usually less than 10 knots from the north and east 50% to 90% of the time, but occasionally in December tropical cyclones move to the southwest along the coast.

These tropical cyclones are not as intense, or as large, as typhoons, but can be a hazard to offshore operations. These storms have an average maximum wave of 40 ft. and an average wind of 80 knots.

There is a diurnal tide of 18 ft. with a spring tide of 27 ft. in the middle of the coast and the tide is over 10 ft. for 700 miles of coast line. These are the highest tides in the Indian Ocean. □

Source: Institute of Storm Research

Florida

A geophysical survey has indicated the highly productive Sunniland formation located onshore the South Florida basin could have significant potential offshore.

The prospect arose from a survey taken by GECO Geophysical Co. in preparation for a Gulf of Mexico lease sale in 1985. The survey identified four potential reservoirs, as well as source rocks and possible traps, the company said in a recent American Association of Petroleum Geologists publication.

Since its discovery in 1943 by then-Humble Oil and Refining Co., the Sunniland formation has produced several million bbl of oil. The formation, however, was never extended offshore south Florida- a region that remains relatively virgin.

The South Florida basin contains more than 25,000 ft. of sediments, mainly carbonates and evaporities and covers about 80,000 sq. miles onshore south Florida and offshore in the Gulf of Mexico, says Barry M. Faulkner, a consulting geologist.

Faulkner and Albert V. Applegate of the Florida Bureau of Geology analyzed the prospects of the area in a paper presented recently to the Gulf Coast Association of Geological Societies in Baton Rouge, La. The paper was entitled "Hydrocarbon Exploration Evaluation of the Pulley Ridge Area, Offshore South Florida Basin."

Texas

Union Exploration Partners Ltd. has discovered natural gas in the Miocene formation on Mustang Island block 740, 42 miles east of Corpus Christi.

The well, **OCS G-5980 No. 1**, flow tested at the rate of 6.46 MMcfd through a 16/64-in. choke from perforations between 11,804 ft. and 11,824 ft.

Meanwhile, Noble Affiliates Inc. of Ardmore Okla. and its partner's high bid of $8,189,000 for Brazos Block A-51 has been accepted by the U.S. Minerals Management Service.

The bid was the highest single offer placed during the Western Gulf of Mexico OCS lease sale in August. The company also participated in a successful bid of $1.12 million for High Island 35.

UK

Chevron was recently testing its **UK16/26-7** well, admidst industry rumors the field may contain up to 300 million bbl recoverable oil.

The find may be linked to a recent completion by Premier on UK22/2 to the south of Chevron's find. The reports of a significant find, however, may be premature, considering the highly complex geology of this quadrant where the Brae complex was also once reported to a single field larger than Forties.

Shell's two new $520 million southern gas fields, Sean North and Sean South, are ready for production. The fields, with reserves of 425 billion cu. ft, can produce 600 million cfd.

The second phase of development will involve placing a compression platform on Sean South after 1990.

Louisiana

A Gulf of Mexico water depth record was established with the spudding of a Shell Offshore Inc. well in the Mississippi Canyon area.

The well is being drilled in 5,400 ft. of water, which surpasses the former record of 3,400 ft. established by Getty Petroleum. The exact block number was not available.

Brazil

Evaluation results of what is believed to be the biggest onshore oil strike in the nation's history has state-owned Petrobras reconsidering expensive deepwater drilling.

The **1-RUC-1 AM** was drilled in the Upper Amazon about 112 miles south of Tefe City and 68 miles east of Jurua. It was drilled to 8,170 ft. and yielded 950 b/d of 43-degree crude. Petrobras says production could easily reach 10,000 b/d.

Wagner Freire, exploration and production director for the state-owned oil company, said the economics favor onshore as opposed to offshore, regardless of the giant discoveries being yeilded in the Campos basin. He estimates the initial oil production in the Amazon Jungle will cost less than $3/bbl, as compared to the estimated $6/bbl for offshore.

The president of Petrobras said if additional onshore drilling results in additional significant discoveries, "future exploration programs could be altered." This statement indicates the offshore regions could be placed on the backburner in favor of cheaper onshore reserves.

Although the onshore discovery is in hostile jungle terrain and the drilling structure had to be transported by helicopter, the cost of drilling the well amounted to only $1.5 million. Additionally, the discovery and others in the immediate area are in close proximity to a river, which would eliminate the need for pipelines and the oil could be shipped via barges.

Norway

BP Petroleum Development Ltd. has declared the Gyda oil field, located on block 2/1, commercial.

The field was discovered in 1980 and since then three appraisal wells have been drilled to determine the size of the field, which is estimated to contain 200 million bbl of oil. Production could begin in 1991 and reach a peak rate of 60,000 b/d of oil and 38 MMcfd of gas.

Gyda is located in a water depth of 66 meters.

Production will take place from a single platform and the oil will be transported through a pipeline to Ekofisk or through an offshore loading system. The gas will be transported through a new pipeline to Ekofisk.

"The declaration of commerciality is subject to satisfactory agreements for the transportation of oil and gas, gas sales and a confirmation of development costs. It is further based on a favorable outcome of the current tax review," the company said.

Angola

A significant oil discovery has been found offshore the northern coast by an international consortium formed by an operating subsidiary of Texaco.

The **Sulele South-1**, located 15 miles on Block 2, flowed at a stabilized rate of 2,735 b/d through a 1/2-in. choke from a Cretaceous dolomite reservoir below 7,200 ft. The well was drilled to a total depth of 8,399 ft. in 106 ft. of water.

Australia

Woodside Petroleum Ltd. has apparently solved doubts about the soundness of a North West Shelf production platform with its multi-million dollar plan to glue the 45,000-ton structure to the rocks lying 120 meters under the ocean floor.

Doubts had been raised concerning the integrity of the North Rankin A platform when the 32 piles went into the seabed far too easily. The underlying rocks consist largely of calciferous or limestone-type soils that are notorious for their instability.

After a lengthy study of the problem, Shell Australia provided an epoxy resin that will be used.

The process involves drilling out the cores of all 32 piles. When the drill reaches the bottom of the piles 120 meters below the seafloor, a drilling technique developed in West Germany will be employed to cut a bell-shaped cavity under each pile.

Once the bell-shaped holes are cut, the epoxy resin and sand mixture will be injected into the holes. This will provide the piles with a stable base that will spread the load on each and prevent any upward movement likely to be caused in the event of the theoretical 100-year cyclone.

BHP Petroleum Ltd., meanwhile, has recorded the fourth successful oil flow from the Challis field in the Timor Sea. In a test over the interval 1,390 to 1,410 meters, the **Challis 4** well flowed at the rate of 2,317 b/d through a 5/8-in. choke.

The test result comes one month since BHP reported the record flow from its **Challis 3** well. Challis 3 tested oil at the rate of 9,989 b/d through a 1.5-in. choke. This was slightly better than the record set in February when the **Challis 2** flowed 9,380 b/d of oil.

Analysts said the Challis 4 results were "reasonably encouraging and virtually ensured" the field would be commercial. The Challis reserves are now estimated at 50 million bll.

Meanwhile, operators report production from Bass Strait, the nation's premier oil field, has dropped to 176,000 b/d. This compares to the previous low point of 250,000 b/d.

The latest figures represent a sharp deterioration from the July production rate of 442,000 b/d. Six of the field's wells have been shut-in as non-producers. □

Mobile Rig Scrappings/Retirements

Name	Type	Owner
Ben Ocean Typhoon	Drillship	Ben Odeco
C-203	Drill Barge	Lagoven
Compass Driller	Drillship	Energy
Df-82	Jackup	Dixilyn-Field
Df-83	Jackup	Dixilyn-Field
Dolphin Titan 101	Jackup	Dolphin Titan
Dolphin Titan 102	Jackup	Dolphin Titan
Dolphin Titan 104	Jackup	Dolphin Titan
John Hayward	Submersible	Odeco
Mexico	Jackup	Perforadora
Movible 3	Submersible	Teledyne
Mr Sam	Jackup	Fluor
Navifor Norse	Drillship	Cosifor
Ocean Cyclone	Drillship	Odeco
Ocean Hurricane	Drillship	Odeco
Odeco Seven	Submersible	Odeco
Quarles 21	Submersible	Quarles
Sedco 135G	Semisubmersible	Sedco Forex
Sedco 150	Jackup	Sedco Forex
Sedneth I	Semisubmersible	Sea Drlg Netherlands Bv
Sedneth Ii	Jackup	Sea Drlg Netherlands Bv
St Louis	Submersible	Odeco
Topper Ii	Jackup	Zapata
Transocean I	Jackup	Transworld
Transworld 50	Jackup	Transworld
Wodeco Vii	Drill Barge	Fluor

(December 1986)

Mobile Rig Name Changes

Name/Exname	Type	New Owner/Exowner
Dan Duchess Wodeco Viii	Drillship	Lauritzen Fluor Drilling
Five Star Eniwetok	Drillship	Beacon Drilling
KCA Kingfisher Polly Bristol	Drillship	KCA Offshore Rosshold
Sagar Prabhat Samudra Prabhat	Drillship	Ongc Viking Offshore
Wodeco Ix (Ocean Clipper) Wodeco Ix To Feb 87	Drillship	Odeco Fluor Drilling
Ag-V Ss-5	Jackup	Andrade Gutierrez Stewart & Stevenson
Ag-Vi Key West	Jackup	Andrade Gutierrez Santa Fe;keydri
Amaralina Orion	Jackup	Unap Sonat Offshore Co
Etesco V Zapata Endeavour	Jackup	Etesco Zapata Off-Shore Corp
KCA Sandpiper Stc Platon	Jackup	KCA Offshore Stc Ventures
Miss Kitty Bonito I	Jackup	Zapata Off-Shore Corp Bonito Offshore
Ocean Columbia Mr Dave To Dec 86	Jackup	Odeco Fluor Drilling
Ocean Sentry Mr Sage To Dec 86;Wodeco X	Jackup	Odeco Fluor Drilling
Ocean Titan Mr Si To Dec 86	Jackup	Odeco Fluor Drilling
Ocean Tower Mr Mel To Dec 86	Jackup	Odeco Fluor Drilling
Sagar Lakshmi Sagar Vikas	Jackup	Ongc

(continued)

Name/Exname	Type	New Owner/Exowner
South Sea 3 South Seas Iii	Jackup	Foramer
Zapata Bonanza Jfp Vii	Jackup	Zapata Off-Shore Corp Jfp
Arctic Sunrise Glomar Arctic Ii To Jan 87	Semisubmersible	Den Norske Creditbank Global Marine
Doo Sung Big Dipper	Semisubmersible	Korea Drilling
Nanhai V Bow Drill 2 To Dec 86	Semisubmersible	Nanhai West Bow Valley
Neddrill Vi Afortunada	Semisubmersible	Neddrill
Petrobras Vii Bendoran; Atlantic Ii	Semisubmersible	Petrobras/Gepem/Ditic Ben Line/Mgmt Atlantic
Petrolia Safe Petrolia	Semisubmersible	Wcb International Consafe Offshore Ab
Vinni Safe Tritonia	Semisubmersible	Sds Drilling Consafe Offshore Ab

(December 1986)

Units Cold Stacked/Mothballed/For Sale By Location

Name	Type	Status	Location
Kulluk	Arctic Drilling	Mothballed	Arctic
Molikpaq	Arctic Drilling	Mothballed	Arctic
Bow Drill 1	Semisubmersible	Cold Stacked	Canadian East Coast
Bluewater 3	Semisubmersible	Mothballed	Caribbean
Bohai Vi	Jackup	Cold Stacked	Far East
Df-76	Submersible	Mothballed	Gulf of Mexico
Df-80	Jackup	Mothballed	Gulf of Mexico
Glomar Atlantic	Drillship	Cold Stacked	Gulf of Mexico
Offshore Pegasus	Jackup	For Sale	Gulf of Mexico
Glomar Pacific	Drillship	Cold Stacked	Gulf of Mexico
Transworld 59	Jackup	Mothballed	Gulf of Mexico
Transworld 63	Jackup	Mothballed	Gulf of Mexico
Transworld 64	Jackup	Mothballed	Gulf of Mexico
Transworld 65	Submersible	Mothballed	Gulf of Mexico
Transworld 71	Jackup	Mothballed	Gulf of Mexico
Dolphin Titan 103	Jackup	Cold Stacked	Gulf of Mexico
Dolphin Titan 105	Jackup	Cold Stacked	Gulf of Mexico
Dolphin Titan 106	Jackup	Cold Stacked	Gulf of Mexico
Houtech Iii	Jackup	For Sale	Gulf of Mexico
Apache	Jackup	For Sale	Gulf of Mexico
Bluewater 2	Submersible	Cold Stacked	Gulf of Mexico
Gulfdrill	Jackup	For Sale	Gulf of Mexico
Jfp Ix	Jackup	Mothballed	Gulf of Mexico
Nordrill Seahawk	Jackup	For Sale	Gulf of Mexico
Ocean Conquest	Jackup	Cold Stacked	Gulf of Mexico
Santa Fe Mariner Iii	Semisubmersible	Mothballed	Gulf of Mexico
Zapata Neptune	Semisubmersible	Cold Stacked	Gulf of Mexico
S-55	Submersible	Cold Stacked	Gulf of Mexico
Ocean Star	Jackup	Cold Stacked	Gulf of Mexico
Ocean Traveler	Semisubmersible	Cold Stacked	Gulf of Mexico
Barge A	Submersible	Cold Stacked	Gulf of Mexico
Sabine Iii	Jackup	Cold Stacked	Gulf of Mexico
Diamond M 99	Jackup	Mothballed	Gulf of Mexico
Diamond M Gem	Jackup	Mothballed	Gulf of Mexico
Ocean Driller	Semisubmersible	Cold Stacked	Gulf of Mexico
Ocean Rover	Semisubmersible	Cold Stacked	Gulf of Mexico
Ocean Prospector	Semisubmersible	Cold Stacked	Gulf of Mexico
Ocean Viking	Semisubmersible	Cold Stacked	Gulf of Mexico
Gulftide	Jackup	Cold Stacked	Gulf of Mexico
Ocean Chief	Jackup	Cold Stacked	Gulf of Mexico
Gulfstream	Jackup	Cold Stacked	Gulf of Mexico
Ocean Scout	Semisubmersible	Cold Stacked	Gulf of Mexico
Cbi-1	Submersible	For Sale	Gulf of Mexico

(continued)

Name	Type	Status	Location
Pentagone 82	Semisubmersible	Cold Stacked	Gulf of Mexico
Sabine Ii	Jackup	Cold Stacked	Gulf of Mexico
Robert N Haskin	Jackup	For Sale	Gulf of Mexico
Bigfoot I	Jackup	For Sale	Gulf of Mexico
Mr Demp	Jackup	For Sale	Gulf of Mexico
Petrolia	Semisubmersible	Cold Stacked	Mediterranean
Santa Fe Mariner Ii	Semisubmersible	Cold Stacked	Mediterranean
Tourmalines	Jackup	For Sale	Middle East
Santa Fe Mariner I	Semisubmersible	Cold Stacked	Middle East
Galveston Key	Jackup	Cold Stacked	North Sea
Dundee Kingsnorth	Semisubmersible	Mothballed	North Sea
Arctic Sunrise	Semisubmersible	For Sale	North Sea
Bideford Dolphin	Semisubmersible	Cold Stacked	North Sea
Aladdin	Semisubmersible	Cold Stacked	North Sea
Ali Baba	Semisubmersible	Cold Stacked	North Sea
Sinbad Saxon	Semisubmersible	Cold Stacked	North Sea
Zapata Arctic	Semisubmersible	Cold Stacked	Oceania
Interocean Discoverer	Drillship	Cold Stacked	South America
Baruna I	Drill Barge	Cold Stacked	Southeast Asia
Chancellorsville	Drillship	Cold Stacked	Southeast Asia
Chris Seger	Jackup	For Sale	Southeast Asia
Five Star	Drillship	For Sale	Southeast Asia
Santa Fe Explorer	Jackup	For Sale	Southeast Asia
Santa Fe 135	Semisubmersible	Cold Stacked	Western Europe
Santa Fe 140	Semisubmersible	Cold Stacked	Western Europe

(JANUARY 1987)

MOBILE RIGS
Unit Types By Age

Total Drillship Age 10 Years Or Less

Name	Owner	Del(Age)	Location
Sedco/BP 471	Sedco Forex	01/01/78	Costa Rica;Central America;Pac
Glomar Atlantic	Global Marine	01/01/78	United States;Gulf of Mexico;A
Pacnorse I	Pacnorse	06/01/79	Brazil;South America
KCA Kingfisher	KCA Offshore	06/01/81	Netherlands;North Sea;Verolme
Valentin Shashin	USSR	11/01/81	Ussr;Eastern Europe;Barents SE
Sagar Prabhat	Ongc	05/01/82	India;Southern Asia;Andaman
Victor Muravelenko	USSR	09/01/82	USSR;Eastern Europe;Barents SE
Energy Searcher	Pacific Supplier	10/01/82	Australia;Oceania;Timor Sea
Five Star	Beacon Drilling	12/01/82	Singapore;Southeast Asia
Mikhail Merchink	USSR	12/01/82	Vietnam;Southeast Asia
Glomar Robert F Bauer	Global Marine	10/01/83	Thailand;Southeast Asia
Sagar Vijay	Ongc	02/01/85	India;Southern Asia;Bombay Hig

Total Drillship Age 10-15 Years

Name	Owner	Del(Age)	Location
Petrobras II	Petrobras	01/01/73	Brazil;South America;Rio de Ja
Canmar Explorer III	Canadian Marine	01/01/73	Canada;Arctic;Tuk
Canmar Explorer IV	Canadian Marine	01/01/73	Canada;Arctic;Tuk
Glomar Coral Sea	Global Marine	01/01/74	Malta;Mediterranean
Regional Endeavour	Western Selcast	01/01/74	Singapore;Southeast Asia
Tainaron	Tropic	01/01/75	Brazil;South America;Rio de Ja
Danwood Ice	Lauritzen	01/01/75	Egypt;Middle East;Mediterranea
Benlomond	Ben Line	01/01/75	Greece;Mediterranean
Zapata Trader	Zapata	01/01/75	Singapore;Southeast Asia
Douglas Carver	Reading & Bates	01/01/75	Spain;Western Europe;Cadiz
Dan Duchess	Lauritzen	01/01/75	Taiwan;Far East;Kaohsiung
Discoverer 534	Sonat	01/01/75	United States;Gulf of Mexico;L
Ocean Tempest	Odeco	01/01/75	United States;Gulf of Mexico;L

(continued)

Name	Owner	Del(Age)	Location
Ben Ocean Lancer	Ben Odeco	01/01/76	Brazil;South America;Rio de Ja
Discoverer 511	Sonat	01/01/76	Brazil;South America;Rio de Ja
Pelerin	I/S Dynamic	01/01/76	Brazil;South America;Rio de Ja
Canmar Explorer	Canadian Marine	01/01/76	Canada;Arctic;Tuk
Petrel	Offshore Europe	01/01/76	India;Southern Asia;Andaman
Chancellorsville	Atwood Oceanics	01/01/76	Singapore;Southeast Asia
Wodeco IX (Ocean Clipper)	Odeco	01/01/76	Somalia;Africa;Arabian Sea
Dan Baron	Lauritzen	01/01/76	Taiwan;Far East
Discoverer Seven Seas	Sonat	01/01/76	United States;Gulf of Mexico;L
Canmar Explorer II	Canadian Marine	01/01/76	United States;US West Coast;AL
Neddrill I	Neddrill	10/10/76	Brazil;South America
Sedco 472	Sedco Forex	01/01/77	Brazil;South America
Interocean Discoverer	Sonat	01/01/77	Brazil;South America;Rio de Ja
Sedco 445	Sedco Forex	01/01/77	Singapore;Southeast Asia
Iro Frigg	Iro Frigg Ltd	01/01/77	Spain;Mediterranean;Algeciras
Seacrest	Seacrest	01/01/77	Thailand;Southeast Asia;Gulf O
Neddrill II	Neddrill	01/01/77	Tunisia;Africa;Mediterranean
Glomar Pacific	Global Marine	01/01/77	United States;Gulf of Mexico;A

Total Drillship Age 15+ Years

Name	Owner	Del(Age)	Location
E W Thornton	Protech	01/01/65	Egypt;Middle East;Gulf of Suez
Glomar Conception	Global Marine	01/01/67	Malta;Mediterranean
Glomar Grand Isle	Global Marine	01/01/67	Singapore;Southeast Asia
Discoverer III	Sonat	01/01/70	Malaysia;Southeast Asia
Pelican II	Offshore Europe	01/01/72	France;Mediterranean;Marseille
Saipem Due	Saipem	01/01/72	Italy;Mediterranean;Adriatic S
Glomar Grand Banks	Global Marine	01/01/72	Malta;Mediterranean

Total Jackup Age 10 Years Or Less

Name	Owner	Del(Age)	Location
Trident II	Sedco Forex	02/01/77	Malaysia;Southeast Asia
Hakuryu VI	Japan Drilling	01/01/78	Abu Dhabi;Middle East;Arabian
Petrobras V	Petrobras	01/01/78	Brazil;South America;Ceara Bas
Sivash	USSR	01/01/78	Bulgaria;Eastern Europe;Black
Ron Tappmeyer	Reading & Bates	01/01/78	Netherlands;North Sea
Pool 143	Pool Arabia	01/01/78	Saudi Arabia;Middle East;Arabi
Penrod 80	Penrod	01/01/78	United Kingdom;North Sea
Galveston Key	Santa Fe	01/01/78	United Kingdom;North Sea;Black
Ocean Columbia	Odeco	01/01/78	United States;Gulf of Mexico;L
Rowan Fort Worth	Rowan	01/01/78	United States;Gulf of Mexico;L
Teledyne 18	Teledyne	01/01/78	United States;Gulf of Mexico;L
NN-1	Noble Joint Venture	01/01/78	United States;Gulf of Mexico;L
J Storm VIII	Marine Drilling	01/01/78	United States;Gulf of Mexico;L
Sabine I	Houston Offshore	01/01/78	United States;Gulf of Mexico;L
Nueces I	Houston Offshore	01/01/78	United States;Gulf of Mexico;L
Teledyne 19	Teledyne	01/01/78	United States;Gulf of Mexico;T
J Storm VII	Marine Drilling	01/01/79	United States;Gulf of Mexico;L
Penrod 82	Penrod	01/01/79	United States;Gulf of Mexico;L
J Storm IX	Marine Drilling	01/01/79	United States;Gulf of Mexico;T
Norbe I	Odebrecht	02/01/79	Brazil;South America
Randolph Yost	Reading & Bates	02/01/79	United States;Gulf of Mexico;T
DF-85	Sonat	03/01/79	United States;Gulf of Mexico;L
Bohai VI	Cnooc	04/01/79	China;Far East;yellow Sea
Trident III	Sedco Forex	04/01/79	Dubai;Middle East;Arabian Gulf
Acadian Spirit	Huthnance	04/01/79	United States;Gulf of Mexico;L
Ocean Conquest	Odeco	04/01/79	United States;Gulf of Mexico;L
Penrod 81	Penrod	05/01/79	Netherlands;North Sea
Montreal III	Montreal	06/01/79	Brazil;South America;Rio Grand
Apache	Marad	06/01/79	United States;Gulf of Mexico;L
Glomar High Island I	Global Marine	06/01/79	United States;Gulf of Mexico;L
Gulfstream	Marad	06/01/79	United States;Gulf of Mexico;L

(continued)

Name	Owner	Del(Age)	Location
Keyes 150	Keyes	06/01/79	United States;Gulf of Mexico;T
Western Triton II	Western Oceanic	06/01/79	Venezuela;South America;Lake M
Transocean V	Transworld	07/01/79	Dubai;Middle East;Arabian Gulf
Penrod 83	Penrod	07/01/79	United States;Gulf of Mexico;L
Al Yasat	National Drlg Abu Dh	10/01/79	Abu Dhabi;Middle East;Arabian
Marlin 14	Marlin	10/01/79	Brazil;South America
Bigfoot II	Patterson	10/01/79	United States;Gulf of Mexico;L
Western Triton III	Western Oceanic	10/01/79	United States;Gulf of Mexico;L
Bigfoot I	Barclay American	10/01/79	United States;Gulf of Mexico;T
Tourmalines	Interdrill	11/01/79	Abu Dhabi;Middle East;Arabian
Western Triton IV	Western Oceanic	11/01/79	United States;Gulf of Mexico;T
Junana	National Drlg Abu Dh	11/30/79	Abu Dhabi;Middle East;Arabian
Nanhai IV	Nanhai West	12/01/79	China;Far East
South Sea 3	Foramer	12/01/79	Malaysia;Southeast Asia
J Storm XI	Marine Drilling	01/01/80	United States;Gulf of Mexico;L
Diyina	National Drlg Abu Dh	02/01/80	Abu Dhabi;Middle East;Arabian
Bohai VIII	Cnooc	03/01/80	China;Far East;Bohai
Bohai X	Cnooc	03/01/80	China;Far East;Bohai
Trident IV	Sedco Forex	03/01/80	Nigeria;west Africa;Africa
Rowan Middletown	Rowan	03/01/80	United States;Gulf of Mexico;L
Broughton I	Broughton	03/01/80	United States;Gulf of Mexico;L
Offshore Comet	Sonat	04/01/80	Egypt;Middle East;Gulf of Suez
Glomar High Island II	Global Marine	04/01/80	Egypt;Middle East;Suez Bay
Sabine II	Houston Offshore	04/01/80	United States;Gulf of Mexico;T
Petrobaltic I	Petrobaltic	04/01/80	Ussr;Eastern Europe;Baltic Sea
Diamond M Magallanes	Diamond M	05/01/80	Chile;South America;Strait of
W T Adams	Reading & Bates	05/01/80	Dubai;Middle East
Trident V	Sedco Forex	05/01/80	Dubai;Middle East;Arabian Gulf
Sneferu	Egyptian Drilling	05/01/80	Egypt;Middle East;Gulf of Suez
Perro Negro 2	Saipem	05/01/80	Italy;Mediterranean;Adriatic S
Nahuatl	Protexa	05/01/80	Mexico;Central America;Bay of
J Storm XII	Marine Drilling	05/01/80	United States;Gulf of Mexico;L
Keyes 250	Keyes	05/01/80	United States;Gulf of Mexico;M
Sedneth Luanda	Sea Drlg Netherlands	06/01/80	Angola;west Africa;Africa
J Storm XIV	Marine Drilling	06/01/80	United States;Gulf of Mexico;L
Gulfwind	Chiles	06/01/80	United States;Gulf of Mexico;L
Rowan Paris	Rowan	06/01/80	United States;Gulf of Mexico;T
Jfp V	Lajfp Drilling	06/01/80	United States;Gulf of Mexico;T
Df-86	Sonat	07/01/80	United States;Gulf of Mexico;T
Oxa	USSR	07/01/80	Ussr;Far East;Sakhalin Island
Glomar High Island III	Global Marine	09/01/80	Gabon;west Africa;Africa
D R Stewart	Reading & Bates	09/01/80	India;Southern Asia;Andaman
Key Bermuda	Santa Fe	09/01/80	Nigeria;west Africa;Africa
Gulfdrill	Den Norske Creditban	10/01/80	United States;Gulf of Mexico;L
Ocean Spartan	Odeco	11/01/80	Brazil;South America
Sagar Lakshmi	Ongc	11/01/80	India;Southern Asia
Ocean Master III	Loffland Brothers	11/01/80	Saudi Arabia;Middle East;Arabi
Pool 144	Pool Arabia	11/01/80	Saudi Arabia;Middle East;Arabi
Don e Mcmahon	Diamond M	11/01/80	United States;Gulf of Mexico;L
Commanche	Gecc	11/01/80	United States;Gulf of Mexico;T
Ile du Levant	Foramer	12/01/80	Angola;west Africa;Africa;Luan
Santa Fe 124	Santa Fe	12/01/80	Egypt;Middle East;Mediterranea
Glomar High Island IV	Global Marine	12/01/80	United States;Gulf of Mexico;L
Key Manhattan	Santa Fe	12/01/80	United States;Gulf of Mexico;L
Senusret	Egyptian Drilling	01/01/81	Egypt;Middle East;Gulf of Suez
Baruna II	Pt Patra	01/01/81	Indonesia;Southeast Asia;Nw Ja
Perro Negro 5	Saipem	01/01/81	Italy;Mediterranean;Ionian Sea
J Storm Xv	Marine Drilling	01/01/81	United States;Gulf of Mexico;L
Keyes 200	Keyes	01/01/81	United States;Gulf of Mexico;L
Sedco 252	Sedco Forex	03/01/81	India;Southern Asia;Bombay Hig
Trident VI	Sedco Forex	03/01/81	Qatar;Middle East;Arabian Gulf
Trident VII	Sedco Forex	03/01/81	Singapore;Southeast Asia
Charles Rowan	Rowan	03/01/81	United Kingdom;North Sea;Great
Transworld 71	Transworld	03/01/81	United States;Gulf of Mexico;L
Broughton II	Broughton	03/01/81	United States;Gulf of Mexico;L
Offshore Jupiter	Sonat	04/01/81	Abu Dhabi;Middle East;Arabian
Sedco 251	Sedco Forex	04/01/81	Angola;west Africa;Africa
Maersk Viking	Maersk Drilling	04/01/81	Egypt;Middle East;Mediterranea
Glomar High Island V	Global Marine	04/01/81	Gabon;west Africa;Africa

(continued)

Name	Owner	Del(Age)	Location
Griffin-Alexander I	Griffin-Alexander	04/01/81	India;Southern Asia;Bay of Ben
Zapoteca	Protexa	04/01/81	Mexico;Central America;Bay of
Transocean VI	Transworld	04/01/81	Netherlands;North Sea
Hakuryu VII	Japan Drilling	04/01/81	Singapore;Southeast Asia
Western Apollo I	Western Oceanic	04/01/81	United Kingdom;North Sea;Great
Ocean Spur	Odeco	04/01/81	United States;Gulf of Mexico;T
Sedco 160	Sedco Forex	05/01/81	Abu Dhabi;Middle East;Arabian
Totonaca	Protexa	05/01/81	Mexico;Central America;Bay of
Sabine III	Houston Offshore	05/01/81	United States;Gulf of Mexico;L
Uxmal	Permargo Internation	06/01/81	India;Southern Asia
Semar	Pt Patra	06/01/81	Indonesia;Southeast Asia
Keyes 300	Keyes	06/01/81	United States;Gulf of Mexico;L
Griffin-Alexander II	Griffin-Alexander	06/01/81	United States;Gulf of Mexico;L
Maersk Victory	Maersk Drilling	07/01/81	Abu Dhabi;Middle East;Arabian
Maersk Valiant	Maersk Drilling	07/01/81	Australia;Oceania;western Aust
Glomar Adriatic I	Global Marine	07/01/81	Gabon;west Africa;Africa
Santa Fe 127	Santa Fe	07/01/81	Indonesia;Southeast Asia;Java
Sagar Pragati	Ongc	07/01/81	Japan;Far East
Ocean Benarmin	Ben Odeco	07/01/81	United Kingdom;North Sea
Arch Rowan	Rowan	07/01/81	United Kingdom;North Sea;Great
Df-87	Sonat	07/01/81	United States;Gulf of Mexico;L
J Storm Xvi	Marine Drilling	07/01/81	United States;Gulf of Mexico;L
Penrod 84	Penrod	07/01/81	United States;Gulf of Mexico;L
Sabine IV	Gecc	07/01/81	United States;Gulf of Mexico;L
Glomar High Island VI	Global Marine	07/01/81	United States;Gulf of Mexico;L
Western Apollo II	Western Oceanic	08/01/81	United Kingdom;North Sea;Great
Zapata Heritage	Zapata	08/01/81	United States;Gulf of Mexico;A
Keyes 301	Keyes	08/01/81	United States;Gulf of Mexico;L
Houtech I	Gecc	08/01/81	United States;Gulf of Mexico;L
Pool 53	Pool	08/01/81	United States;Gulf of Mexico;L
Prober 94	Penrod	08/01/81	United States;Gulf of Mexico;L
Trident VIII	Sedco Forex	09/01/81	Nigeria;west Africa;Africa
Sedco 253	Sedco Forex	09/01/81	Portugal;western Europe;Setuba
Glomar Adriatic II	Global Marine	09/01/81	United States;Gulf of Mexico;L
J Storm Xvii	Marine Drilling	09/01/81	United States;Gulf of Mexico;T
Dan Duke	Lauritzen	10/01/81	Ivory Coast;west Africa;Africa
Gilbert Rowe	Rowan	10/01/81	United Kingdom;North Sea;Great
Griffin-Alexander III	Griffin-Alexander	10/01/81	United States;Gulf of Mexico;L
Houtech II	Gecc	10/01/81	United States;Gulf of Mexico;L
Nordrill Oiler	Nordrill Ltd I	10/01/81	United States;Gulf of Mexico;L
Penrod 95	Penrod	11/01/81	Egypt;Middle East;Gulf of Suez
Zapata Scotian	Zapata	11/01/81	Netherlands;North Sea
Dyvi Epsilon	Dyvi Offshore	11/01/81	Norway;North Sea;Kristiansund
Hakuryu 8	Japan Drilling	11/01/81	Singapore;Southeast Asia
Zapata Sovereign	Zapata	11/01/81	Singapore;Southeast Asia
Penrod 85	Penrod	11/01/81	United Kingdom;North Sea
Harvey H Ward	Reading & Bates	12/01/81	Brunei;Southeast Asia
Neddrill IV	Neddrill	12/01/81	Netherlands;North Sea
Dyvi Sigma	Dyvi Offshore	12/01/81	United Kingdom;North Sea
Bill Bailey	Nealwell	12/01/81	United States;Gulf of Mexico;L
Charger I	Charger I Ltd	12/01/81	United States;Gulf of Mexico;L
Charger II	Huthnance	12/01/81	United States;Gulf of Mexico;L
Nordrill Falcon	Nordrill Ltd II	12/01/81	United States;Gulf of Mexico;L
Nike I	Western Oceanic	12/01/81	United States;Gulf of Mexico;L
Ed Holt	Noble	12/01/81	United States;Gulf of Mexico;T
Keyes 302	Keyes	12/01/81	United States;Gulf of Mexico;T
Bob Warner	Nealwell	12/01/81	United States;Gulf of Mexico;T
Mr Demp	Seattle First Nat Bn	12/01/81	United States;Gulf of Mexico;T
Sedneth 201	Sea Drlg Netherlands	01/01/82	Abu Dhabi;Middle East;Arabian
Petrobras VI	Petrobras	01/01/82	Angola;west Africa;Africa
Dan Earl	Lauritzen	01/01/82	United Kingdom;North Sea
Griffin-Alexander IV	Griffin-Alexander	01/01/82	United States;Gulf of Mexico;L
Vanguard I	Huthnance	01/01/82	United States;Gulf of Mexico;L
Nordrill Steeler	Nordrill Ltd II	01/01/82	United States;Gulf of Mexico;L
Chichen Itza	Permargo Chichen Sa	02/01/82	India;Southern Asia;Bombay Hig
Arabdrill 8	Arabian Drilling	02/01/82	Saudi Arabia;Middle East;Khafj
Trident X	Sedco Forex	02/01/82	United Kingdom;North Sea
Penrod 86	Penrod	02/01/82	United States;Gulf of Mexico;L
Jfp III	Jfp Energy	02/01/82	United States;Us West Coast;Ca
Santa Fe 134	Santa Fe	03/01/82	Indonesia;Southeast Asia;Java

(continued)

Name	Owner	Del(Age)	Location
Roger W Mowell	Reading & Bates	03/01/82	Italy;Mediterranean;Sicily
Cheyenne	Gecc	03/01/82	United States;Gulf of Mexico;L
Cliffs Lasalle	Cliffs	03/01/82	United States;Gulf of Mexico;L
Pool 54	Pool	03/01/82	United States;Gulf of Mexico;L
Houtech III	First City Bank	03/01/82	United States;Gulf of Mexico;L
Griffin-Alexander V	Griffin-Alexander	03/01/82	United States;Gulf of Mexico;T
Penrod 88	Penrod	03/01/82	United States;Gulf of Mexico;T
Sedneth 202	Sea Drlg Netherlands	04/01/82	Abu Dhabi;Middle East;Arabian
Yemilah	National Drlg Abu Dh	04/01/82	Abu Dhabi;Middle East;Arabian
Amazone	Saga	04/01/82	Benin;west Africa;Africa
Trident IX	Sedco Forex	04/01/82	Congo;west Africa;Africa
Key Singapore	Santa Fe	04/01/82	Malaysia;Southeast Asia;Sarawa
Ocean Master IV	Loffland Brothers	04/01/82	United Arab Emirates;Middle Ea
Glomar Main Pass I	Global Marine	04/01/82	United Kingdom;North Sea;Firth
Cecil Provine	Rowan	04/01/82	United Kingdom;North Sea;Great
Yucatan	Chiles	04/01/82	United States;Gulf of Mexico;A
Glomar High Island VII	Global Marine	04/01/82	United States;Gulf of Mexico;L
Cliffs Marquette	Cliffs	04/01/82	United States;Gulf of Mexico;T
Bohai V	Cnooc	05/01/82	China;Far East;Bohai
Jalapa	Perforadora	05/01/82	Mexico;Central America;Gulf Of
Shelf Driller	Houlder	05/01/82	United Kingdom;North Sea
Griffin-Alexander VI	Griffin-Alexander	05/01/82	United States;Gulf of Mexico;L
Maersk Voyager	Maersk Drilling	06/01/82	Abu Dhabi;Middle East;Arabian
Western Apollo III	Western Oceanic	06/01/82	Abu Dhabi;Middle East;Arabian
Western Apollo IV	Western Oceanic	06/01/82	Abu Dhabi;Middle East;Arabian
Andros	Drilling Investment	06/01/82	Netherlands;North Sea
Maersk Venturer	Maersk Drilling	06/01/82	Thailand;Southeast Asia
KCA Sandpiper	KCA Offshore	06/01/82	United Kingdom;North Sea;Inver
Penrod 87	Penrod	06/01/82	United States;Gulf of Mexico;L
Jfp IX	Jfp International	06/01/82	United States;Gulf of Mexico;L
Ocean Sentry	Odeco	06/01/82	United States;Gulf of Mexico;L
Penrod 90	Penrod	06/01/82	United States;Gulf of Mexico;L
Penrod 96	Penrod	06/01/82	United States;Gulf of Mexico;L
Griffin-Alexander VII	Griffin-Alexander	06/01/82	United States;Gulf of Mexico;T
Norbe II	Odebrecht	07/01/82	Brazil;South America
Penrod 92	Penrod	07/01/82	United Kingdom;North Sea;Great
Glomar Main Pass II	Si Construction	07/01/82	United States;Gulf of Mexico;L
Montreal IV	Montreal	08/01/82	Brazil;South America;Rio de Ja
Glomar Adriatic III	Global Marine	08/01/82	Netherlands;North Sea
Neddrill III	Neddrill	08/01/82	Netherlands;North Sea
Pool 145	Pool Arabia	08/01/82	Saudi Arabia;Middle East;Arabi
Zapata Bonanza	Zapata	08/01/82	United Kingdom;North Sea
Ponca	Savage	08/01/82	United States;Gulf of Mexico;L
Bohai VII	Cnooc	09/01/82	China;Far East;Bohai
Maersk Endeavour	Maersk Drilling	09/01/82	Denmark;North Sea
Santa Fe 136	Santa Fe	09/01/82	Egypt;Middle East;Gulf of Suez
Sagar Shakti	Ongc	09/01/82	India;Southern Asia;Bombay Hig
Glomar Main Pass III	Global Marine	09/01/82	Indonesia;Southeast Asia
Mr Ric	Phoenix	09/01/82	United States;Gulf of Mexico;L
Teledyne 20	Teledyne	09/01/82	United States;Gulf of Mexico;L
Penrod 97	Penrod	09/01/82	United States;Gulf of Mexico;T
Robert M Womack	Trinidad Gulf Drilli	09/01/82	United States;Gulf of Mexico;T
Robert N Haskin	Royal Bank of Canada	09/01/82	United States;Gulf of Mexico;T
Ag-V	Andrade Gutierrez	10/01/82	Brazil;South America
Santa Fe 141	Santa Fe	10/01/82	Egypt;Middle East
Penrod 93	Penrod	10/01/82	Egypt;Middle East;Gulf of Suez
Miss Kitty	Zapata	10/01/82	India;Southern Asia;Bombay Hig
Orizont-1	Petromar	10/01/82	Romania;Eastern Europe;Black S
Trident XI	Sedco Forex	10/01/82	United Kingdom;North Sea
Penrod 89	Penrod	10/01/82	United States;Gulf of Mexico;L
Vanguard II	Huthnance	10/01/82	United States;Gulf of Mexico;L
Glomar High Island VIII	Global Marine	11/01/82	Egypt;Middle East;Suez Bay
Sagar Gaurav	Ongc	11/01/82	India;Southern Asia;Bombay Hig
Keyes 303	Keyes	11/01/82	United States;Gulf of Mexico;L
J Storm Xviii	Marine Drilling	11/01/82	United States;Gulf of Mexico;T
H L Cecil	Magnum Drilling	12/01/82	Egypt;Middle East;Gulf of Suez
W B Tyson	Reading & Bates	12/01/82	Italy;Mediterranean
Zacateca	Perforadora	12/01/82	Mexico;Central America;Gulf Of
Rowan Halifax	Rowan	12/01/82	Netherlands;North Sea
Morecambe Flame	Hydrocarbons Great B	12/01/82	United Kingdom;western Europe;

(continued)

Name	Owner	Del(Age)	Location
Seabee	Gecc	12/01/82	United States;Gulf of Mexico;L
Dolphin Titan 105	Dolphin Titan	12/01/82	United States;Gulf of Mexico;L
Dolphin Titan 106	Dolphin Titan	12/01/82	United States;Gulf of Mexico;L
Glomar Main Pass IV	Global Marine	12/01/82	United States;Gulf of Mexico;L
Sam Noble	Noble	12/01/82	United States;Gulf of Mexico;T
Sabine V	Houston Offshore	12/01/82	United States;Gulf of Mexico;T
26Th Communist Party	USSR	12/01/82	Ussr;Eastern Europe;Caspian Se
Dual 38	Dual Offshore	01/01/83	Indonesia;Southeast Asia
Transocean VII	Transworld	01/01/83	Netherlands;North Sea
Neddrill Trigon	Trigon	01/01/83	United Kingdom;North Sea
Bay Driller	Hydrocarbons Great B	01/01/83	United Kingdom;western Europe;
Bonito II	Zapata	02/01/83	India;Southern Asia
Sagar Jyoti	Ongc	02/01/83	India;Southern Asia;Bombay Hig
Parameswara	Gerudi Satu	02/01/83	Malaysia;Southeast Asia;Sarawa
Ocean Master V	Loffland Brothers	02/01/83	Saudi Arabia;Middle East;Arabi
Ocean Master VI	Loffland Brothers	02/01/83	Saudi Arabia;Middle East;Arabi
Penrod 91	Penrod	02/01/83	United States;Gulf of Mexico;T
Glomar Adriatic VIII	Global Marine	03/01/83	Egypt;Middle East;Suez Bay
Marawah	Drillocean	04/01/83	Abu Dhabi;Middle East
Ocean Master VII	Loffland Brothers	04/01/83	Saudi Arabia;Middle East;Arabi
Marlin 17	Marlin	04/01/83	United States;Gulf of Mexico;L
Petrobras XI	Petrobras	05/01/83	Brazil;South America;Espirito
Ocean Master VIII	Loffland Brothers	05/01/83	Saudi Arabia;Middle East;Arabi
Pool 55	Pool	05/01/83	United States;Gulf of Mexico;L
Glomar High Island IX	Global Marine	06/01/83	Brazil;South America;Amazon Ri
Dual 42	Dual Offshore	06/01/83	Indonesia;Southeast Asia
Perro Negro 3	Saipem	06/01/83	Italy;Mediterranean;Adriatic S
Glomar Adriatic IV	Global Marine	06/01/83	Malta;Mediterranean
Al Baz	Kuwait Oil (Ksc)	08/01/83	Bahrain;Middle East;Arabian Gu
Glomar Labrador I	Global Marine	09/01/83	United Kingdom;North Sea;Firth
Rowan California	Rowan	11/01/83	Netherlands;North Sea
Rowan Gorilla I	Rowan	12/01/83	Canada;Canadian East Coast;Nov
Nengue Sika	Wadi	12/01/83	Gabon;west Africa;Africa
28Th of April	USSR	12/01/83	Ussr;Eastern Europe;Caspian Se
Glomar Moray Firth I	Global Marine	01/01/84	United Kingdom;North Sea;Firth
Bohai IX	Cnooc	03/01/84	China;Far East;Dalian
Bohai XI	Cnooc	03/01/84	China;Far East;Dalian
Labin	Ina Naftaplin	03/01/84	Yugoslavia;Eastern Europe;Adri
Jfp XI	Jfp Energy	04/01/84	New Zealand;Oceania;North Isla
Ekhabi	Vietsovpetro	05/01/84	Vietnam;Southeast Asia
Hakuryu 9	Japan Drilling	07/01/84	China;Far East;Bohai Bay
Prometeu	Petromar	07/01/84	Romania;Eastern Europe;Black S
Chazar	USSR	08/01/84	Ussr;Eastern Europe;Sea of Okh
Rowan Gorilla II	Rowan	10/01/84	United Kingdom;North Sea
Glomar Baltic I	Global Marine	12/01/84	United States;Gulf of Mexico;L
Penrod 98	Penrod	12/01/84	United States;Gulf of Mexico;L
Rowan Gorilla III	Rowan	12/01/84	United States;Gulf of Mexico;T
George H Galloway	Reading & Bates	01/01/85	Trinidad;Caribbean
Penrod 99	Penrod	01/01/85	United States;Gulf of Mexico;L
Sagar Ratna	Ongc	02/01/85	India;Southern Asia;Bombay Hig
40 Years of Victory	USSR	02/01/85	Ussr;Eastern Europe;Caspian Se
Shahid Rajai	Nioc	03/01/85	Iran;Middle East;Persian Gulf
Fortuna	Petromar	05/01/85	Romania;Eastern Europe;Black S
Kolskaja	USSR	07/01/85	Ussr;Eastern Europe;Barents Se
Sakhalinskaya	USSR	11/01/85	Ussr;Far East;Sea of Okhotsk
Columbus Explorer	Foramer/Fels	06/01/86	Singapore;Southeast Asia
Rowan Gorilla IV	Rowan International	07/01/86	United States;Gulf of Mexico;L
Maersk Guardian	Maersk Drilling	08/15/86	Denmark;North Sea
Maersk Giant	Maersk Drilling	10/01/86	Taiwan;Far East
Transworld 74	Transworld	12/31/86	United Kingdom;western Europe;

Total Jackup Age 10-15 Years

Name	Owner	Del(Age)	Location
Offshore Antares	Sonat	01/01/73	Abu Dhabi;Middle East;Arabian
Ag-Vi	Andrade Gutierrez	01/01/73	Brazil;South America;Rio de Ja
Sagar Samrat	Ongc	01/01/73	India;Southern Asia;Bombay Hig

(continued)

Name	Owner	Del(Age)	Location
Penrod 64	Penrod	01/01/73	Netherlands;North Sea;Den Held
Ocean 66 (Platform B)	Odeco	01/01/73	United States;Gulf of Mexico;L
Teledyne 16	Teledyne	01/01/73	United States;Gulf of Mexico;L
Ocean King	Odeco	01/01/73	United States;Gulf of Mexico;T
Petrobras III	Petrobras	01/01/74	Brazil;South America;Rio de Ja
Santa Fe 103	Santa Fe	01/01/74	Indonesia;Southeast Asia;Java
Shahid Modarres	Nioc	01/01/74	Iran;Middle East;Arabian Gulf
C e Thornton	Reading & Bates	01/01/74	Nigeria;west Africa;Africa
Key Victoria	Santa Fe	01/01/74	Nigeria;west Africa;Africa
Ocean Titan	Odeco	01/01/74	United States;Gulf of Mexico;L
Teledyne 17	Teledyne	01/01/74	United States;Gulf of Mexico;L
Ranger III	Atlantic Pacific	01/01/74	United States;Gulf of Mexico;L
Transworld 62	Transworld	01/01/74	United States;Gulf of Mexico;L
J Storm III	Citmar	01/01/74	United States;Gulf of Mexico;T
Ile d'Amsterdam	Foramer	10/01/74	India;Southern Asia
Al Ittihad	National Drlg Abu Dh	01/01/75	Abu Dhabi;Middle East;Arabian
Naymin Yaung	Myanma Oil (Moc)	01/01/75	Burma;Southern Asia;Gulf of Ma
Maersk Explorer	Maersk Drilling	01/01/75	Denmark;North Sea
Santa Fe 105	Santa Fe	01/01/75	Egypt;Middle East;Gulf of Suez
Offshore Bahram	Sonat	01/01/75	Egypt;Middle East;Gulf of Suez
Western Polaris I	Western Oceanic	01/01/75	Gabon;west Africa;Africa
Shenandoah	Atwood Oceanics	01/01/75	India;Southern Asia
F G Mclintock	Reading & Bates	01/01/75	Netherlands;North Sea
Ocean Champion	Odeco	01/01/75	United States;Gulf of Mexico;L
J Storm IV	Marine Drilling	01/01/75	United States;Gulf of Mexico;L
Diamond M Gem	Diamond M	01/01/75	United States;Gulf of Mexico;L
Penrod 65	Penrod	01/01/75	United States;Gulf of Mexico;L
Rowan Alaska	Rowan	01/01/75	United States;Gulf of Mexico;T
Df-84	Sonat	01/01/75	United States;Gulf of Mexico;T
Rowan Louisiana	Rowan	01/01/75	United States;Gulf of Mexico;T
Baku	USSR	01/01/75	Ussr;Eastern Europe;Caspian Se
Hakuryu IV	Japan Drilling	05/01/75	Singapore;Southeast Asia
Penrod 66	Penrod	11/01/75	United States;Gulf of Mexico;L
Scan Bay	Scan Drilling	01/01/76	Abu Dhabi;Middle East;Arabian
Western Polaris II	Western Oceanic	01/01/76	Angola;west Africa;Africa
Diamond M Nugget	Diamond M	01/01/76	Chile;South America;Strait of
Nanhai I	Nanhai West	01/01/76	China;Far East
Kan Tan II	Mog of Prc	01/01/76	China;Far East;E China Sea
Key Largo	Santa Fe	01/01/76	Gabon;west Africa;Africa
D K Mcintosh	Reading & Bates	01/01/76	Indonesia;Southeast Asia
Penrod 67	Penrod	01/01/76	Netherlands;North Sea
Transocean IV	Transworld	01/01/76	Netherlands;North Sea
Ednastar	North Korea	01/01/76	North Korea;Far East;Korean Ba
Penrod 69	Penrod	01/01/76	Oman;Middle East;Arabian Sea
Dana	Qgpc	01/01/76	Qatar;Middle East;Arabian Gulf
Gloria	Petromar	01/01/76	Romania;Eastern Europe;Black S
Western Triton I	Western Oceanic	01/01/76	United Arab Emirates;Middle Ea
Vicksburg	Atwood Oceanics	01/01/76	United States;Gulf of Mexico;A
Transworld 63	Transworld	01/01/76	United States;Gulf of Mexico;L
Transworld 64	Transworld	01/01/76	United States;Gulf of Mexico;L
Nordrill Seahawk	Den Norske Creditban	01/01/76	United States;Gulf of Mexico;L
Offshore Taurus	Sonat	01/01/76	United States;Gulf of Mexico;L
Penrod 68	Penrod	01/01/76	United States;Gulf of Mexico;L
Horizon	Chiles	01/01/76	United States;Gulf of Mexico;L
Key Gibraltar	Santa Fe	01/01/76	Yemen;Middle East;Arabian Sea
Al Ghallan	National Drlg Abu Dh	01/01/77	Abu Dhabi;Middle East;Arabian
Bohai IV	Cnooc	01/01/77	China;Far East;Bohai
Maersk Endurer	Maersk Drilling	01/01/77	Egypt;Middle East;Gulf of Suez
Offshore Aquarius	Sonat	01/01/77	Egypt;Middle East;Gulf of Suez
Interocean III	Interocean	01/01/77	Egypt;Middle East;Mediterranea
Perro Negro 4	Saipem	01/01/77	Egypt;Middle East;Red Sea
Azteca	Protexa	01/01/77	India;Southern Asia
Maya	Protexa	01/01/77	Mexico;Central America;Bay of
Dyvi Beta	Dyvi Offshore	01/01/77	Norway;North Sea;Kristiandsund
Dyvi Gamma	Dyvi Offshore	01/01/77	Norway;North Sea;Newcastle
Pool 142	Pool Arabia	01/01/77	Saudi Arabia;Middle East;Arabi
Interocean II	Interocean	01/01/77	United Kingdom;North Sea;Sunde
Penrod 63	Penrod	01/01/77	United States;Gulf of Mexico;L
Ranger IV	Atlantic Pacific	01/01/77	United States;Gulf of Mexico;L

(continued)

Name	Owner	Del(Age)	Location
Rowan Juneau	Rowan	01/01/77	United States;Gulf of Mexico;L
Rowan Odessa	Rowan	01/01/77	United States;Gulf of Mexico;L
Pool 50	Pool	01/01/77	United States;Gulf of Mexico;L
J Storm VI	Marine Drilling	01/01/77	United States;Gulf of Mexico;T
Panon	Ina Naftaplin	01/01/77	Yugoslavia;Eastern Europe;Adri

Total Jackup Age 15+ Years

Name	Owner	Del(Age)	Location
Norbe IV	Odebrecht	01/01/56	Brazil;South America;Rio Grand
Offshore Pegasus	Sonat	01/01/57	United States;Gulf of Mexico;A
Mr Gus II	Odeco	01/01/57	United States;Gulf of Mexico;L
Hakuryu I	Japan Drilling	01/01/58	Egypt;Middle East;Gulf of Suez
Hudson Bay	Abay Holdings	01/01/58	Gabon;west Africa;Africa
Perro Negro	Saipem	01/01/61	Italy;Mediterranean;Sicily
Df-80	Sonat	01/01/63	United States;Gulf of Mexico;A
Ocean Liberty (Platform B	Odeco	01/01/64	United States;Gulf of Mexico;L
Hustler	Sonat	01/01/65	Abu Dhabi;Middle East;Arabian
Jubilee	Sonat	01/01/65	Abu Dhabi;Middle East;Arabian
Etesco V	Etesco	01/01/65	Brazil;South America
North Star I	Schahin Cury	01/01/65	Brazil;South America
Timesaver II	Underwater Gas Devel	01/01/65	Canada;Great Lakes;Port Stanle
Mr Jack	Reading & Bates	01/01/65	Italy;Mediterranean;Ionian Sea
Ile de France	Foramer	01/01/65	United Arab Emirates;Middle Ea
Ocean Patriot (Platform D	Odeco	01/01/65	United States;Gulf of Mexico;L
Penrod 54	Penrod	01/01/65	United States;Gulf of Mexico;L
Penrod 53	Penrod	01/01/65	United States;Gulf of Mexico;L
Marlin 3	Marlin	01/01/65	United States;Gulf of Mexico;L
Ocean Pride	Odeco	01/01/65	United States;Gulf of Mexico;L
Penrod 55	Penrod	01/01/65	United States;Gulf of Mexico;L
Penrod 57	Penrod	01/01/66	Abu Dhabi;Middle East;Abu Dhab
Amaralina	Unap	01/01/66	Brazil;South America;Ceara
Norbe III	Odebrecht	01/01/66	Brazil;South America;Rio Grand
Chaparral	P&e Drilling	01/01/66	Qatar;Middle East;Arabian Gulf
Amdp 2	Aramco	01/01/66	Saudi Arabia;Middle East
Dolphin Titan 143	Dolphin Titan	01/01/66	Singapore;Southeast Asia
Penrod 56	Penrod	01/01/66	United Arab Emirates;Middle Ea
Ocean Leader	Odeco	01/01/66	United States;Gulf of Mexico;L
Marlin 4	Marlin	01/01/66	United States;Gulf of Mexico;L
Aspheron	USSR	01/01/66	Ussr;Eastern Europe;Caspian Se
Montreal I	Montreal	01/01/67	Brazil;South America;Rio de Ja
Cowrie I	Remm	01/01/67	Nigeria;west Africa;Africa
Transworld 59	Transworld	01/01/67	United States;Gulf of Mexico;L
Guiftide	Odeco	01/01/67	United States;Gulf of Mexico;L
Stormdrill V	Marine Drilling	01/01/67	United States;Gulf of Mexico;T
Khazar	USSR	01/01/67	Ussr;Eastern Europe;Caspian Se
Petrobras I	Petrobras	01/01/68	Brazil;South America;Rio de Ja
Penrod 58	Penrod	01/01/68	Greece;Mediterranean
Britannia	Santa Fe	01/01/68	United Kingdom;North Sea
Petrobras IV	Petrobras	01/01/69	Brazil;South America
Rowan Houston	Rowan International	01/01/69	United States;Gulf of Mexico;L
Dolphin Titan 103	Dolphin Titan	01/01/69	United States;Gulf of Mexico;L
Ocean Star	Odeco	01/01/69	United States;Gulf of Mexico;L
Ocean Chief	Odeco	01/01/69	United States;Gulf of Mexico;L
Penrod 59	Penrod	01/01/69	United States;Gulf of Mexico;L
J Storm I	Marine Drilling	01/01/69	United States;Gulf of Mexico;T
Ocean Tide	Ben Odeco	01/01/70	Egypt;Middle East;Gulf of Suez
Offshore Mercury	Sonat	01/01/70	Egypt;Middle East;Gulf of Suez
J W Mclean	Reading & Bates	01/01/70	India;Southern Asia;Bombay Hig
Chris Seger	Reading & Bates	01/01/70	Singapore;Southeast Asia
Santa Fe Explorer	Santa Fe	01/01/70	Singapore;Southeast Asia
Rowan New Orleans	Rowan International	01/01/70	United States;Gulf of Mexico;T
Ocean Ruler	Odeco	01/01/71	United States;Gulf of Mexico;L
Marlin 6	Marlin	01/01/71	United States;Gulf of Mexico;L
Penrod 60	Penrod	01/01/71	United States;Gulf of Mexico;L
Western Delta	Western Oceanic	01/01/71	United States;Gulf of Mexico;T

(continued)

Name	Owner	Del(Age)	Location
Azerbaijan	USSR	01/01/71	Ussr;Eastern Europe;Caspian Se
Penrod 62	Penrod	01/01/72	Brazil;South America;Rio de Ja
Zapata Nordic	Zapata	01/01/72	Netherlands;North Sea
Ocean Tower	Odeco	01/01/72	United States;Gulf of Mexico;L
Diamond M 99	Diamond M	01/01/72	United States;Gulf of Mexico;L
Rowan Anchorage	Rowan International	01/01/72	United States;Gulf of Mexico;T
Rowan Texas	Rowan Drilling	01/01/72	United States;Gulf of Mexico;T
J Storm X	Marine Drilling	01/01/72	United States;Gulf of Mexico;T

Total Jackup Age Undetermined

Name	Owner	Del(Age)	Location
Maersk Vanguard	Maersk Drilling		Egypt;Middle East;Gulf of Suez
Atlas	Petromar		Romania;Eastern Europe;Black S
Key Hawaii	Santa Fe		United States;Us West Coast;Al
Crc Rig 33	Crc Mallard		United States;Gulf of Mexico;L
60 Years of October	USSR		Ussr;Eastern Europe;Caspian Se

Total Semisubmersible Age 10 Years Or Less

Name	Owner	Del(Age)	Location
Hakuryu V	Japan Drilling	08/01/77	Singapore;Southeast Asia
Neddrill VI	Neddrill	03/01/79	Netherlands;North Sea;Rotterda
Caspmormeft	USSR	07/01/79	Ussr;Eastern Europe;Caspian Se
Bow Drill 1	Bow Valley	01/01/81	Canada;Canadian East Coast;New
Shelf 1	USSR	01/01/81	Ussr;Eastern Europe;Caspian Se
Dyvi Delta	Dyvi Offshore	03/01/81	Norway;North Sea;Haltenbank
Treasure Swan	Wilhelmsen	10/01/81	Norway;North Sea;Haugesund
Choctaw I	Santa Fe	10/01/81	United States;Gulf of Mexico;L
Diamond M Hunter	Diamond M	12/01/81	United States;Gulf of Mexico;L
Treasure Scout	Wilhelmsen	03/01/82	Norway;North Sea
Petrobras IX	Petrobras	05/01/82	Brazil;South America;Rio de Ja
Petrobras X	Petrobras	05/01/82	Brazil;South America;Rio de Ja
Vinland	Sds Drilling	07/01/82	Canada;Canadian East Coast;Nov
Diamond M Eagle	Diamond M	08/01/82	United States;Gulf of Mexico;L
West Vanguard	Smedvig	09/01/82	Norway;North Sea;Halsenoey Fjo
John Shaw	Sonat	09/01/82	United States;Gulf of Mexico;A
Penrod 73	Penrod	09/01/82	United States;Gulf of Mexico;L
Drill Star	Sedco Forex	10/01/82	United Kingdom;North Sea
Sedco/BP 711	Sedco Forex/BP	10/01/82	United Kingdom;North Sea
Actinia	Actinia	11/01/82	South Africa;Southern Africa;A
Jim Cunningham	Reading & Bates	12/01/82	China;Far East;South China Sea
Deepsea Bergen	Deep Sea Drilling	12/01/82	Norway;North Sea
Nymphea	Nymphea	12/01/82	South Africa;Southern Africa;A
Shelf 2	USSR	12/01/82	Ussr;Eastern Europe;Caspian Se
Sedco 710	Sedco Forex/Petrocan	02/01/83	Canada;Canadian East Coast;New
Ross Isle	Ross	02/01/83	Norway;North Sea
Diamond M Falcon	Diamond M	02/01/83	United States;Us West Coast;Ca
Petrobras Xv	Petrobras	03/01/83	Brazil;South America;Rio de Ja
Sedco 600	Sedco Forex	03/01/83	China;Far East;Hong Kong
M G Hulme Jr	Reading & Bates	03/01/83	United Kingdom;North Sea
Dyvi Omega	Dyvi Offshore	03/01/83	United Kingdom;North Sea;Firth
Penrod 78	Penrod	03/01/83	United States;Gulf of Mexico;L
Penrod 76	Penrod	03/01/83	United States;Gulf of Mexico;L
Ocean Odyssey	Odeco	03/01/83	United States;Us West Coast;wa
Petrobras XII	Petrobras	04/01/83	Brazil;South America;Rio de Ja
Petrobras Xiv	Petrobras	04/01/83	Brazil;South America;Rio de Ja
Dyvi Stena	Stena	04/01/83	Norway;North Sea;Kristiansund
Santa Fe 135	Santa Fe	04/01/83	United Kingdom;western Europe;
Sedco 601	Sedco Forex/Union Te	05/01/83	United States;Gulf of Mexico;T
Petrobras XIII	Petrobras	06/01/83	Brazil;South America;Rio de Ja
Benreoch	Ben Line	06/01/83	United Kingdom;North Sea
Nanhai V	Nanhai West	07/01/83	China;Far East;South China Sea
High Seas Driller	Houlder	07/01/83	United Kingdom;North Sea
Western Pacesetter IV	Western Oceanic	08/01/83	United Kingdom;North Sea;Scotl
Penrod 77	Penrod	09/01/83	United States;Gulf of Mexico;L
Sedco 712	Sedco Forex/Phillips	09/01/83	United States;Us West Coast;Ca

(continued)

Name	Owner	Del(Age)	Location
Sedco 602	Sedco Forex/Occident	10/01/83	China;Far East;S China Sea
Santa Fe 140	Santa Fe	10/01/83	United Kingdom;western Europe;
Sedco 714	Sedco Forex/Ranger	11/01/83	United Kingdom;North Sea;Scotl
Glomar Arctic I	Global Marine	12/01/83	United Kingdom;North Sea;Firth
Sovereign Explorer	Scotdril	12/01/83	United Kingdom;western Europe;
Petrobras Xvi	Petrobras	01/01/84	Brazil;South America;Rio de Ja
Petrobras Xvii	Petrobras	01/01/84	Brazil;South America;Rio de Ja
Bow Drill 3	Bow Valley	01/01/84	Canada;Canadian East Coast;New
Arctic Sunrise	Den Norske Creditban	01/01/84	United Kingdom;North Sea;Firth
Shelf 3	USSR	01/01/84	Ussr;Eastern Europe;Caspian Se
Zapata Arctic	Zapata	02/01/84	Fiji;Oceania;South Pacific
Doo Sung	Korea Drilling	04/01/84	United States;Us West Coast;Ca
Kan Tan III	Mog of Prc	07/01/84	China;Far East;E China Sea
Glomar Arctic III	Global Marine	12/01/84	United Kingdom;North Sea;Firth
Shelf 4	USSR	12/01/84	Ussr;Eastern Europe;Barents Se
Sea Explorer	BP	01/01/85	United Kingdom;North Sea
Henry Goodrich	Sonat	07/01/85	Norway;North Sea;Stavanger
Polar Pioneer	Polar Frontier	08/01/85	Norway;North Sea;Haltenbank
Vinni	Sds Drilling	12/01/85	Norway;North Sea;Bergen
Shelf 5	USSR	06/01/86	Ussr;Eastern Europe;Gulf of Fi
Ross Rig	Ross	08/01/86	Norway;North Sea;Sandefjord
Shelf 6	USSR	10/01/86	Ussr;Far East;Sea of Okhotsk
Norjarl	Norcem	10/15/86	Korea;Far East
Petrolia	Wcb International	11/01/86	France;Mediterranean
Zane Barnes	Reading & Bates	11/20/86	United States;Gulf of Mexico;L
Dyvi Alpha	Dyvi	12/31/86	Japan;Far East
West Vision	Smedvig	01/01/87	Korea;Far East

Total Semisubmersible Age 10-15 Years

Name	Owner	Del(Age)	Location
Santa Fe Mariner II	Santa Fe	01/01/73	Malta;Mediterranean
West Venture	Smedvig	01/01/73	Norway;North Sea;Stavanger
Sedco K	Sedco Forex	01/01/73	South Africa;Southern Africa;A
Ocean Voyager	Odeco	01/01/73	Spain;Mediterranean
Buchan A	BP	01/01/73	United Kingdom;North Sea
Sedneth 701	Sea Drlg Netherlands	01/01/73	United Kingdom;North Sea
Glomar Biscay II	Global Marine	01/01/73	United Kingdom;North Sea;Firth
Aladdin	Jebsens	01/01/73	United Kingdom;North Sea;Scotl
Western Pacesetter I	Hanover Trust	01/01/73	United Kingdom;North Sea;Scotl
Ocean Kokuei	Odeco	01/01/73	United Kingdom;western Europe;
Sedco 702	Sedco Forex	01/01/73	United States;Gulf of Mexico;L
Penrod 70	Penrod	01/01/73	United States;Gulf of Mexico;L
Ocean Rover	Odeco	01/01/73	United States;Gulf of Mexico;L
Diamond M Century	Diamond M	01/01/73	United States;Gulf of Mexico;L
Pentagone 82	Sedco Forex	01/01/73	United States;Gulf of Mexico;T
Margie	Atwood Oceanics	01/01/74	Australia;Oceania;western Aust
Chris Chenery	Sonat	01/01/74	Brazil;South America
Penrod 71	Penrod	01/01/74	Brazil;South America;Rio de Ja
Zephyr II	Odeco	01/01/74	Brazil;South America;Rio de Ja
Df-95	Sonat	01/01/74	India;Southern Asia;Bombay Hig
Hakuryu III	Japan Drilling	01/01/74	Japan;Far East
Glomar Biscay I	Global Marine	01/01/74	Malta;Mediterranean
Byford Dolphin	Fred Olsen	01/01/74	Norway;North Sea
Zapata Ugland	Zapata	01/01/74	Norway;North Sea;Stavanger
Sedco 700	Sedco Forex	01/01/74	United Kingdom;North Sea
Ocean Liberator	Odeco	01/01/74	United Kingdom;North Sea;Inver
Pentagone 84	Sedco Forex	01/01/74	United Kingdom;North Sea;Inver
Sedco 703	Sedco Forex	01/01/74	United Kingdom;North Sea;Inver
Sedco 704	Sedco Forex	01/01/74	United Kingdom;North Sea;Inver
Sinbad Saxon	Jebsens	01/01/74	United Kingdom;North Sea;Scotl
Western Pacesetter III	Hanover Trust	01/01/74	United States;Gulf of Mexico;L
Zapata Whittington	Zapata	01/01/74	United States;Gulf of Mexico;L
Penrod 74	Penrod	01/01/74	United States;Gulf of Mexico;L
Ocean Scout	Odeco	01/01/74	United States;Gulf of Mexico;L
Diamond M New Era	Diamond M	01/01/74	United States;Gulf of Mexico;L
Nanhai II	Nanhai West	12/31/74	China;Far East;East China Sea
Asterie	Forasol Sa	01/01/75	Brazil;South America;Rio de Ja

(continued)

Name	Owner	Del(Age)	Location
Scarabeo 3	Saipem	01/01/75	Italy;Mediterranean;Sicily
Borgsten Dolphin	Fred Olsen	01/01/75	Norway;North Sea
Benvrackie	Ben Line	01/01/75	United Kingdom;North Sea
Deepsea Pioneer	Deep Sea Drilling	01/01/75	United Kingdom;North Sea
Ocean Nomad	Odeco	01/01/75	United Kingdom;North Sea
Stadrill	Shell Uk	01/01/75	United Kingdom;North Sea
Bideford Dolphin	Blandford	01/01/75	United Kingdom;North Sea;Peter
Df-96	Sonat	01/01/75	United Kingdom;North Sea;Scotl
Marlin 7	Marlin	01/01/75	United States;Gulf of Mexico;L
Ocean Endeavor	Odeco	01/01/75	United States;Gulf of Mexico;L
Zapata Concord	Zapata	01/01/75	United States;Gulf of Mexico;L
Bluewater 4	Santa Fe	01/01/75	United States;Gulf of Mexico;L
Western Pacesetter II	Hanover Trust	01/01/75	United States;Gulf of Mexico;L
Penrod 72	Penrod	01/01/75	United States;Gulf of Mexico;T
Kingsnorth Uk	Kingsnorth	10/01/75	United Kingdom;North Sea
Dundee Kingsnorth	Kingsnorth	10/01/75	United Kingdom;North Sea;Dunde
General Enrique Mosconi	Ypf	01/01/76	Argentina;South America
Southern Cross	Santa Fe	01/01/76	Australia;Oceania;New South Wa
Zapata Lexington	Zapata	01/01/76	Brazil;South America
Petrobras VII	Petrobras/Gepem	01/01/76	Brazil;South America;Rio de Ja
Nortrym	Norcem	01/01/76	Norway;North Sea;Haugesund
Ocean Bounty	Odeco	01/01/76	United Kingdom;North Sea
Sedco 707	Sedco Forex/Shell	01/01/76	United Kingdom;North Sea;Inver
Ali Baba	Jebsens	01/01/76	United Kingdom;North Sea;Scotl
Alaskan Star	Western Oceanic/Exxo	01/01/76	United States;Gulf of Mexico;L
Sedco 706	Sedco Forex	01/01/76	United States;Gulf of Mexico;L
Zapata Saratoga	Zapata	01/01/76	United States;Gulf of Mexico;L
Zapata Yorktown	Zapata	01/01/76	United States;Gulf of Mexico;L
Scarabeo 4	Saipem	01/01/76	United States;Gulf of Mexico;L
Penrod 75	Penrod	01/01/76	United States;Gulf of Mexico;L
Aleutian Key	Santa Fe	01/01/76	United States;Gulf of Mexico;L
Santa Fe Mariner III	Santa Fe	01/01/76	United States;Gulf of Mexico;L
Rowan Midland	Rowan	01/01/76	United States;Gulf of Mexico;T
Diamond M General	Diamond M	01/01/76	United States;Us West Coast;Ca
Diamond M Epoch	Diamond M	01/01/77	Australia;Oceania;Tasmania;Lau
Maersk Pioneer	Maersk Drilling	01/01/77	Brazil;South America;Rio de Ja
Sedco 709	Sedco Forex/Shell	01/01/77	Canada;Canadian East Coast;Nov
South Seas Driller	Houlder	01/01/77	China;Far East
Sedco 708	Sedco Forex	01/01/77	China;Far East;South China Sea
Borgny Dolphin	Fred Olsen	01/01/77	Norway;North Sea
Vildkat	Sds Drilling	01/01/77	Norway;North Sea
Treasure Hunter	Wilhelmsen	01/01/77	Norway;North Sea;Bergen
Treasure Seeker	Wilhelmsen	01/01/77	United Kingdom;North Sea
Ocean Benloyal	Ben Odeco	01/01/77	United Kingdom;North Sea;Inver
Df-97	Sonat	01/01/77	United Kingdom;North Sea;Scotl
Zapata Neptune	Zapata	01/01/77	United States;Gulf of Mexico;L
Zagreb-1	Ina-Naftaplin	01/01/77	Yugoslavia;Eastern Europe;Adri

Total Semisubmersible Age 15+ Years

Name	Owner	Del(Age)	Location
Ocean Driller	Odeco	01/01/63	United States;Gulf of Mexico;L
Ocean Explorer	Odeco	01/01/64	United States;Gulf of Mexico;L
Sedco 135D	Sedco Forex	01/01/66	Brazil;South America;Rio de Ja
Sedco Echo	Sedco Forex	01/01/66	Brunei;Southeast Asia
Bluewater 3	Santa Fe	01/01/66	Trinidad;Caribbean;Port of Spa
Transworld 58	Transworld	01/01/66	United Kingdom;North Sea;Scotl
Ocean Traveler	Odeco	01/01/66	United States;Gulf of Mexico;L
Ocean Digger	Odeco/Ampol/Aidc	01/01/67	Brazil;South America;Rio de Ja
Sedco 135F	Sedco Forex	01/01/67	Brazil;South America;Rio de Ja
Sedco Staflo	Sedco Forex	01/01/67	Brazil;South America;Rio de Ja
Ocean Viking	Odeco	01/01/67	United States;Gulf of Mexico;L
Santa Fe Mariner I	Santa Fe	01/01/68	Egypt;Middle East;Gulf of Suez
Scarabeo 2	Saipem	01/01/68	Italy;Mediterranean;Sicily;Syr
Pentagone 81	Sedco Forex	01/01/69	Brazil;South America;Rio de Ja
Sedco H	Sedco Forex	01/01/69	Spain;Mediterranean
Transworld 61	Transworld	01/01/70	Brazil;South America;Rio de Ja
Sedco I	Sedco Forex	01/01/70	Spain;Mediterranean
Treasure Saga	Wilhelmsen	12/31/70	Norway;North Sea;Kristiansund

(continued)

Name	Owner	Del(Age)	Location
Ocean Prospector	Odeco	01/01/71	United States;Gulf of Mexico;L
Hakuryu II	Japan Drilling	05/01/71	Japan;Far East
Ocean Zephyr	Odeco	01/01/72	Brazil;South America;Rio de Ja
Sedco J	Sedco Forex	01/01/72	Ivory Coast;west Africa;Africa
Ocean Victory	Odeco	01/01/72	United Kingdom;North Sea;Inver

Copyright 1987, Pennwell Publishing Company
Electronic Rig Stats

Worldwide Offshore Mobile Rigs

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Aban/Loyd/Chiles Aban	Griffin-Alexander II Gulf of Mexico	Jackup	200	25000
	Griffin-Alexander III Gulf of Mexico	Jackup	250	25000
Abay Holdings	Hudson Bay West Africa	Jackup	110	15000
Actinia Foramer Sa	Actinia Southern Africa	Semisubmersible	1500	25000
Andrade Gutierrez	Ag-Vi South America	Jackup	350	30000
Andrade Gutierrez Driltech	Ag-V South America	Jackup	150	20000
Arabian Drilling	Arabdrill 8 Middle East	Jackup	150	20000
Aramco	Amdp 2 Middle East	Jackup	200	16000
Atlantic Pacific	Ranger III Gulf of Mexico	Jackup	70	10000
	Ranger IV Gulf of Mexico	Jackup	70	16000
Atwood Oceanics	Gettysburg Southern Asia	Drill Barge	600	20000
	Chancellorsville Southeast Asia	Drillship	1000	20000
	Shenandoah Southern Asia	Jackup	300	20000
	Vicksburg Gulf of Mexico	Jackup	300	20000
	Margie Oceania	Semisubmersible	600	20000
	Richmond ~~Gulf of~~ Mexico	Submersible	70	20000
Aztec Drilling	Aztec Central America	Posted Drill Barge	20	30000
Barclay American	Bigfoot I Gulf of Mexico	Jackup	85	20000
Beacon Drilling Aureole Drilling	Five Star Southeast Asia	Drillship	1000	20000
Beaudril	Molikpaq Arctic	Arctic Drilling Unit	130	19680

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Ben Line Atlantic Drilling	Benlomond Mediterranean	Drillship	750	20000
	Benreoch North Sea	Semisubmersible	1500	25000
Ben Odeco	Ocean Tide Middle East	Jackup	250	20000
Ben Odeco Atlantic Drilling Co Ltd	Ocean Benarmin North Sea	Jackup	205	20000
	Ocean Benloyal North Sea	Semisubmersible	1100	25000
Ben Odeco Odeco	Ben Ocean Lancer South America	Drillship	3000	20000
Blandford Dolphin Services A/S	Bideford Dolphin North Sea	Semisubmersible	1500	25000
Blocker	Catatumbo South America	Drill Barge	110	15000
	Escalante South America	Drill Barge	110	1500
Bow Valley	Bow Drill 1 Canadian East Coast	Semisubmersible	1200	25000
	Bow Drill 3 Canadian East Coast	Semisubmersible	1500	25000
Bp	Buchan A North Sea	Semisubmersible	1200	0
	Sea Explorer North Sea	Semisubmersible	1500	25000
Broughton	Broughton I Gulf of Mexico	Jackup	110	25000
	Broughton II Gulf of Mexico	Jackup	110	25000
Canadian Marine	Canmar Explorer II Us West Coast	Drillship	600	25000
Cbi Offshore	Cbi-1 Gulf of Mexico	Submersible	85	30000
Chiles	Gulfstream Gulf of Mexico	Jackup	150	18000
	Gulfwind Gulf of Mexico	Jackup	150	18000
	Horizon Gulf of Mexico	Jackup	250	20000
	Yucatan Gulf of Mexico	Jackup	300	25000
Citmar Marine Drilling	J Storm III Gulf of Mexico	Jackup	250	25000
Cliffs	Cliffs Lasalle Gulf of Mexico	Jackup	150	25000
	Cliffs Marquette Gulf of Mexico	Jackup	190	25000
Cnooc Nan Hai West	Bohai IV Far East	Jackup	300	25000
	Bohai V Far East	Jackup	197	19680
	Bohai VI Far East	Jackup	250	25000
	Bohai VII Far East	Jackup	197	19680

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Bohai VIII Far East	Jackup	250	20000
	Bohai iX Far East	Jackup	197	19680
	Bohai X Far East	Jackup	250	25000
	Bohai XI Far East	Jackup	197	19680
Crc Mallard	Crc Rig 33 Gulf of Mexico	Jackup	60	1800
Deep Sea Drilling Odfjell	Deepsea Pioneer North Sea	Semisubmersible	1500	25000
Den Norske Creditbank	Arctic Sunrise North Sea	Semisubmersible	1500	25000
Den Norske Creditbank Huthnance	Nordrill Seahawk Gulf of Mexico	Jackup	250	25000
Diamond M	Diamond M 99 Gulf of Mexico	Jackup	300	30000
	Diamond M Gem Gulf of Mexico	Jackup	300	30000
	Diamond M Magallanes South America	Jackup	150	25000
	Diamond M Nugget South America	Jackup	300	30000
	Don e Mcmahon Gulf of Mexico	Jackup	100	25000
	Diamond M Century Gulf of Mexico	Semisubmersible	600	30000
	Diamond M Eagle Gulf of Mexico	Semisubmersible	2000	30000
	Diamond M Epoch Oceania	Semisubmersible	1200	30000
	Diamond M Falcon Us West Coast	Semisubmersible	2000	30000
	Diamond M General Us West Coast	Semisubmersible	1200	30000
	Diamond M Hunter Gulf of Mexico	Semisubmersible	1500	30000
	Diamond M New Era Gulf of Mexico	Semisubmersible	1200	30000
Dolphin Titan	Dolphin Titan 103 Gulf of Mexico	Jackup	70	15000
	Dolphin Titan 105 Gulf of Mexico	Jackup	100	20000
	Dolphin Titan 106 Gulf of Mexico	Jackup	100	20000
	Dolphin Titan 143 Southeast Asia	Jackup	150	20000
Drilling Investment Techfor-Cosifor	Andros North Sea	Jackup	300	22000
Drillocean Techfor-Cosifor	Marawah Middle East	Jackup	150	0
Dual Offshore	Dual 38 Southeast Asia	Jackup	300	20000
	Dual 42 Southeast Asia	Jackup	300	20000
Dyvi Offshore	Dyvi Epsilon North Sea	Jackup	210	25000
	Dyvi Sigma North Sea	Jackup	210	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Dyvi Delta North Sea	Semisubmersible	3000	25000
	Dyvi Omega North Sea	Semisubmersible	1500	30000
Egyptian Drilling	Senusret Middle East	Jackup	225	25000
	Sneferu Middle East	Jackup	225	25000
Etesco	Etesco V South America	Jackup	215	20000
First City Bank	Houtech III Gulf of Mexico	Jackup	73	10000
Foramer	Ile d'Amsterdam Southern Asia	Jackup	300	20000
	Ile de France Middle East	Jackup	200	25000
	Ile du Levant West Africa	Jackup	270	18000
	South Sea 3 Southeast Asia	Jackup	300	20000
Foramer/Fels Foramer	Columbus Explorer Southeast Asia	Jackup	350	25000
Forasol Sa	Asterie South America	Semisubmersible	660	25000
Fred Olsen Dolphin	Borgny Dolphin North Sea	Semisubmersible	1500	30000
	Borgsten Dolphin North Sea	Semisubmersible	750	25000
	Byford Dolphin North Sea	Semisubmersible	1000	25000
Gecc Temple Marine Drilling Inc	Cheyenne Gulf of Mexico	Jackup	200	25000
	Commanche Gulf of Mexico	Jackup	150	25000
	Houtech I Gulf of Mexico	Jackup	73	10000
	Houtech II Gulf of Mexico	Jackup	73	10000
	Sabine IV Gulf of Mexico	Jackup	200	20000
	Seabee Gulf of Mexico	Jackup	250	25000
Gerudi Satu	Parameswara Southeast Asia	Jackup	300	20000
Global Marine	Glomar Beaufort Sea I Arctic	Arctic Drilling Unit	55	25000
	Glomar Atlantic Gulf of Mexico	Drillship	2000	25000
	Glomar Conception Mediterranean	Drillship	600	25000
	Glomar Coral Sea Mediterranean	Drillship	1500	25000
	Glomar Grand Banks Mediterranean	Drillship	600	25000
	Glomar Grand Isle Southeast Asia	Drillship	600	25000
	Glomar Pacific Gulf of Mexico	Drillship	2000	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Glomar Robert F Bauer Southeast Asia	Drillship	2500	25000
	Glomar Adriatic I West Africa	Jackup	300	25000
	Glomar Adriatic II Gulf of Mexico	Jackup	300	25000
	Glomar Adriatic III North Sea	Jackup	300	25000
	Glomar Adriatic IV Mediterranean	Jackup	300	25000
	Glomar Adriatic VIII Middle East	Jackup	300	25000
	Glomar Baltic I Gulf of Mexico	Jackup	375	25000
	Glomar High Island I Gulf of Mexico	Jackup	250	20000
	Glomar High Island II Middle East	Jackup	250	20000
	Glomar High Island III West Africa	Jackup	250	20000
	Glomar High Island IV Gulf of Mexico	Jackup	250	20000
	Glomar High Island V West Africa	Jackup	250	20000
	Glomar High Island VI Gulf of Mexico	Jackup	250	20000
	Glomar High Island VII Gulf of Mexico	Jackup	250	20000
	Glomar High Island VIII Middle East	Jackup	250	20000
	Glomar High Island IX South America	Jackup	250	20000
	Glomar Labrador I North Sea	Jackup	300	25000
	Glomar Main Pass I North Sea	Jackup	300	25000
	Glomar Main Pass III Southeast Asia	Jackup	300	25000
	Glomar Main Pass IV Gulf of Mexico	Jackup	300	25000
	Glomar Moray Firth I North Sea	Jackup	300	25000
	Glomar Arctic I North Sea	Semisubmersible	1800	25000
	Glomar Arctic III North Sea	Semisubmersible	1500	25000
	Glomar Biscay I Mediterranean	Semisubmersible	1500	25000
	Glomar Biscay II North Sea	Semisubmersible	600	25000
Griffin-Alexander	Griffin-Alexander IV Gulf of Mexico	Jackup	200	25000
	Griffin-Alexander V Gulf of Mexico	Jackup	200	25000
	Griffin-Alexander VI Gulf of Mexico	Jackup	200	25000
	Griffin-Alexander VII Gulf of Mexico	Jackup	250	25000
Houlder	Shelf Driller North Sea	Jackup	300	25000
	High Seas Driller North Sea	Semisubmersible	2000	25000
Huthnance	Acadian Spirit Gulf of Mexico	Jackup	112	25000
	Charger II Gulf of Mexico	Jackup	150	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Vanguard I Gulf of Mexico	Jackup	300	25000
	Vanguard II Gulf of Mexico	Jackup	300	25000
Hydrocarbons Great Britain Houlder Offshore Ltd	Bay Driller Western Europe	Jackup	300	25000
	Morecambe Flame Western Europe	Jackup	300	10000
I/S Dynamic Helmer Staubo	Pelerin South America	Drillship	3300	20000
	Labin	Jackup	300	25000
Ina Naftaplin	Eastern Europe			
	Panon Eastern Europe	Jackup	300	20000
	Tourmalines	Jackup	150	20000
Interdrill	Middle East			
Interocean Sonat Offshore	Interocean II North Sea	Jackup	307	20000
	Interocean III Middle East	Jackup	307	20000
	Iro Frigg	Drillship	600	20000
Iro Frigg Ltd	Mediterranean			
	Hakuryu 8	Jackup	186	20000
Japan Drilling	Southeast Asia			
	Hakuryu 9 Far East	Jackup	150	20000
	Hakuryu I Middle East	Jackup	100	12000
	Hakuryu IV Southeast Asia	Jackup	295	25000
	Hakuryu VI Middle East	Jackup	186	20000
	Hakuryu VII Southeast Asia	Jackup	186	20000
	Hakuryu II Far East	Semisubmersible	656	30000
	Hakuryu III Far East	Semisubmersible	1000	30000
	Hakuryu V Southeast Asia	Semisubmersible	1640	30000
Jebsens	Aladdin North Sea	Semisubmersible	650	25000
	Ali Baba North Sea	Semisubmersible	1000	25000
	Sinbad Saxon North Sea	Semisubmersible	650	25000
Jfp Energy	Jfp III Us West Coast	Jackup	300	20000
	Jfp XI Oceania	Jackup	350	25000
Jfp International	Jfp IX Gulf of Mexico	Jackup	90	15000
KCA Offshore	KCA Kingfisher North Sea	Drillship	3300	20000
	KCA Sandpiper North Sea	Jackup	300	25000
Keyes Keyes 303 Venture	Keyes 303 Gulf of Mexico	Jackup	300	25000
Keyes Keyes Offshore Ltd	Keyes 150 Gulf of Mexico	Jackup	150	16000
Keyes Keyes Offshore Ltd Ii	Keyes 250 Gulf of Mexico	Jackup	250	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Keyes Keyes Offshore Ltd Iii	Keyes 200 Gulf of Mexico	Jackup	200	20000
Keyes Keyes Offshore Ltd Iv	Keyes 300 Gulf of Mexico	Jackup	300	20000
	Keyes 301 Gulf of Mexico	Jackup	300	20000
Keyes Keyes Offshore Ltd V	Keyes 302 Gulf of Mexico	Jackup	300	20000
Kingsnorth Houlder Offshore Ltd	Dundee Kingsnorth North Sea	Semisubmersible	1000	25000
	Kingsnorth Uk North Sea	Semisubmersible	1250	25000
Korea Drilling Western Oceanic	Doo Sung Us West Coast	Semisubmersible	1500	25000
Kuwait Oil (Ksc)	Al Baz Middle East	Jackup	300	25000
Lagoven	C-201 South America	Drill Barge	110	10000
	C-202 South America	Drill Barge	110	10000
	C-204 South America	Drill Barge	110	7500
	C-226 South America	Drill Barge	110	10000
	C-227 South America	Drill Barge	110	10000
	C-228 South America	Drill Barge	110	7500
	C-333 South America	Drill Barge	110	7500
	C-334 South America	Drill Barge	110	9000
	C-336 South America	Drill Barge	100	1500
	L-401 South America	Drill Barge	110	15000
	L-402 South America	Drill Barge	110	15000
	L-403 South America	Drill Barge	110	15000
	L-405 South America	Drill Barge	100	13000
Lajfp Drilling Jfp Offshore Inc	Jfp V Gulf of Mexico	Jackup	120	20000
Lauritzen	Dan Baron Far East	Drillship	1000	20000
	Dan Duchess Far East	Drillship	1000	25000
	Danwood Ice Middle East	Drillship	1000	20000
	Dan Duke West Africa	Jackup	300	20000
	Dan Earl North Sea	Jackup	205	20000
Loffland	Ocean Master III Middle East	Jackup	160	14000
	Ocean Master IV Middle East	Jackup	110	18000
	Ocean Master V Middle East	Jackup	160	18000
	Ocean Master VI Middle East	Jackup	160	18000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Ocean Master VII Middle East	Jackup	160	18000
	Ocean Master VIII Middle East	Jackup	160	18000
Maersk Drilling	Maersk Endeavour North Sea	Jackup	251	20000
	Maersk Endurer Middle East	Jackup	250	20000
	Maersk Explorer North Sea	Jackup	205	25000
	Maersk Giant Far East	Jackup	350	20000
	Maersk Guardian North Sea	Jackup	350	20000
	Maersk Valiant Oceania	Jackup	300	20000
	Maersk Vanguard Middle East	Jackup	300	20000
	Maersk Venturer Southeast Asia	Jackup	300	20000
	Maersk Victory Middle East	Jackup	300	20000
	Maersk Viking Middle East	Jackup	300	20000
	Maersk Voyager Middle East	Jackup	300	20000
Magnum Drilling	H L Cecil Middle East	Jackup	200	25000
Manufacturers Hanover	Western Pacesetter I North Sea	Semisubmersible	600	25000
Manufacturers Hanover Atwood Oceanics	Mission Viking Southeast Asia	Drill Barge	600	25000
Marad	Griffin-Alexander I Southern Asia	Jackup	200	25000
	Gulfdrill Gulf of Mexico	Jackup	150	25000
	Sabine II Gulf of Mexico	Jackup	200	20000
	Sabine III Gulf of Mexico	Jackup	200	20000
	Trinity Bay Mediterranean	Posted Drill Barge	20	30000
	Vermilion Bay Southeast Asia	Posted Drill Barge	20	30000
Maraven	Gp-10 South America	Drill Barge	120	17000
	Gp-11 South America	Drill Barge	120	16000
	Gp-12 South America	Drill Barge	120	16000
	Gp-15 South America	Drill Barge	120	16000
	Gp-16 South America	Drill Barge	100	17000
	Gp-9 South America	Drill Barge	120	17000
Marine Drilling	J Storm I Gulf of Mexico	Jackup	225	20000
	J Storm IV Gulf of Mexico	Jackup	250	25000
	J Storm VI Gulf of Mexico	Jackup	250	25000
	J Storm VII Gulf of Mexico	Jackup	377	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	J Storm VIII Gulf of Mexico	Jackup	150	20000
	J Storm IX Gulf of Mexico	Jackup	195	20000
	J Storm X Gulf of Mexico	Jackup	250	20000
	J Storm XI Gulf of Mexico	Jackup	200	20000
	J Storm XII Gulf of Mexico	Jackup	200	20000
	J Storm Xiv Gulf of Mexico	Jackup	200	20000
	J Storm Xv Gulf of Mexico	Jackup	250	25000
	J Storm Xvi Gulf of Mexico	Jackup	250	20000
	J Storm Xvii Gulf of Mexico	Jackup	200	20000
	J Storm Xviii Gulf of Mexico	Jackup	200	25000
	Stormdrill V Gulf of Mexico	Jackup	115	25000
Marlin	Marlin 14 South America	Jackup	150	25000
	Marlin 17 Gulf of Mexico	Jackup	200	20000
	Marlin 3 Gulf of Mexico	Jackup	265	25000
	Marlin 4 Gulf of Mexico	Jackup	175	25000
	Marlin 6 Gulf of Mexico	Jackup	300	30000
	Marlin 7 Gulf of Mexico	Semisubmersible	1000	30000
Mog of Prc Mog	Kan Tan II Far East	Jackup	300	20000
	Kan Tan III Far East	Semisubmersible	660	16400
Montreal	Montreal I South America	Jackup	325	25000
	Montreal III South America	Jackup	250	20000
	Montreal IV South America	Jackup	300	25000
Myanma Oil (Moc) Sedco Forex	Naymin Yaung Southern Asia	Jackup	287	21000
Nanhai West	Nanhai I Far East	Jackup	300	20000
	Nanhai IV Far East	Jackup	300	20000
	Nanhai II Far East	Semisubmersible	1500	25000
	Nanhai V Far East	Semisubmersible	1500	25000
National Drlg Abu Dhabi	Al Ghallan Middle East	Jackup	120	20000
	Al Ittihad Middle East	Jackup	150	20000
	Al Yasat Middle East	Jackup	170	20000
	Diyina Middle East	Jackup	170	20000
	Junana Middle East	Jackup	140	20000
	Yemilah Middle East	Jackup	200	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Nealwell	Bill Bailey Gulf of Mexico	Jackup	115	20000
	Bob Warner Gulf of Mexico	Jackup	115	20000
Neddrill	Neddrill I West Africa	Drillship	1500	25000
	Neddrill II Africa	Drillship	3000	25000
	Neddrill III North Sea	Jackup	250	20000
	Neddrill IV North Sea	Jackup	250	20000
	Neddrill VI West Africa	Semisubmersible	1200	20000
Nioc	Shahid Modarres Middle East	Jackup	250	20000
	Shahid Rajai Middle East	Jackup	300	20000
Noble	Ed Holt Gulf of Mexico	Jackup	300	25000
	Sam Noble Gulf of Mexico	Jackup	300	25000
Noble Joint Venture Noble Drlg Corp	Nn-1 Gulf of Mexico	Jackup	45	25000
Norcem	Norjarl Far East	Semisubmersible	1969	25000
	Nortrym North Sea	Semisubmersible	1000	25000
Nordrill Ltd I Huthnance	Nordrill Oiler Gulf of Mexico	Jackup	200	25000
	Nordrill Falcon Gulf of Mexico	Jackup	200	25000
	Nordrill Steeler Gulf of Mexico	Jackup	200	25000
Nordrill Ltd Ii Huthnance	Nordrill Falcon Gulf of Mexico	Jackup	200	25000
	Nordrill Steeler Gulf of Mexico	Jackup	200	25000
North Korea	Ednastar Far East	Jackup	300	25000
Nymphea Forasol	Nymphea Southern Africa	Semisubmersible	1500	25000
Odebrecht	Norbe III South America	Jackup	290	25000
Odebrecht Triangle Drilling	Norbe I South America	Jackup	300	20000
	Norbe II South America	Jackup	300	25000
Odeco	Ocean Tempest Gulf of Mexico	Drillship	600	25000
	Ocean Clipper Africa	Drillship	750	25000
	Gulftide Gulf of Mexico	Jackup	250	25000
	Mr Gus II Gulf of Mexico	Jackup	150	25000
	Ocean 66 (Platform B) Gulf of Mexico	Jackup	120	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Ocean Champion Gulf of Mexico	Jackup	250	25000
	Ocean Chief Gulf of Mexico	Jackup	225	25000
	Ocean Columbia Gulf of Mexico	Jackup	250	20000
	Ocean Conquest Gulf of Mexico	Jackup	250	20000
	Ocean King Gulf of Mexico	Jackup	340	25000
	Ocean Leader Gulf of Mexico	Jackup	175	25000
	Ocean Liberty (Platform B) Gulf of Mexico	Jackup	80	15000
	Ocean Patriot (Platform D) Gulf of Mexico	Jackup	152	25000
	Ocean Pride Gulf of Mexico	Jackup	152	20000
	Ocean Ruler Gulf of Mexico	Jackup	250	25000
	Ocean Sentry Gulf of Mexico	Jackup	200	25000
	Ocean Spartan South America	Jackup	250	20000
	Ocean Spur Gulf of Mexico	Jackup	250	20000
	Ocean Star Gulf of Mexico	Jackup	173	20000
	Ocean Titan Gulf of Mexico	Jackup	350	30000
	Ocean Tower Gulf of Mexico	Jackup	350	30000
	Ocean Bounty North Sea	Semisubmersible	1500	25000
	Ocean Driller Gulf of Mexico	Semisubmersible	600	20000
	Ocean Endeavor Gulf of Mexico	Semisubmersible	1500	25000
	Ocean Explorer Gulf of Mexico	Semisubmersible	600	20000
	Ocean Kokuei Western Europe	Semisubmersible	600	25000
Odeco	Ocean Liberator North Sea	Semisubmersible	600	25000
	Ocean Nomad North Sea	Semisubmersible	1200	25000
	Ocean Odyssey Us West Coast	Semisubmersible	1500	30000
	Ocean Prospector Gulf of Mexico	Semisubmersible	1000	25000
	Ocean Rover Gulf of Mexico	Semisubmersible	1500	25000
	Ocean Scout Gulf of Mexico	Semisubmersible	1000	25000
	Ocean Traveler Gulf of Mexico	Semisubmersible	600	20000
	Ocean Victory North Sea	Semisubmersible	600	25000
	Ocean Viking Gulf of Mexico	Semisubmersible	600	20000
	Ocean Voyager Mediterranean	Semisubmersible	1000	25000
	Barge A Gulf of Mexico	Submersible	70	25000
	Mr Charlie Gulf of Mexico	Submersible	40	25000
Odeco Ms Drilling	Ocean Zephyr South America	Semisubmersible	600	25000
	Zephyr II South America	Semisubmersible	600	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Odeco/Ampol/Aidc Ms Drilling	Ocean Digger South America	Semisubmersible	800	20000
Offshore Europe Foramer	Pelican II Mediterranean	Drillship	3300	20000
	Petrel Southern Asia	Drillship	3000	25000
P&e Drilling	Chaparral Middle East	Jackup	240	25000
Pacific Supplier Maretech Ocean Services	Energy Searcher Oceania	Drillship	1500	25000
Pacnorse Jebsens Drilling Plc	Pacnorse I South America	Drillship	5000	20000
Patterson	Bigfoot II Gulf of Mexico	Jackup	85	20000
Pembina	Miss Libby Great Lakes	Great Lakes Barge	210	4500
	Mr Chris Great Lakes	Great Lakes Barge	220	6500
Penrod	Penrod 53 Gulf of Mexico	Jackup	300	30000
	Penrod 54 Gulf of Mexico	Jackup	300	30000
	Penrod 55 Gulf of Mexico	Jackup	150	30000
	Penrod 56 Middle East	Jackup	150	30000
	Penrod 57 Middle East	Jackup	150	30000
	Penrod 58 Mediterranean	Jackup	225	30000
	Penrod 59 Gulf of Mexico	Jackup	225	30000
	Penrod 60 Gulf of Mexico	Jackup	326	30000
	Penrod 62 South America	Jackup	320	30000
	Penrod 63 Gulf of Mexico	Jackup	250	25000
	Penrod 64 North Sea	Jackup	210	30000
	Penrod 65 Gulf of Mexico	Jackup	210	30000
	Penrod 66 Gulf of Mexico	Jackup	320	30000
	Penrod 67 North Sea	Jackup	210	30000
	Penrod 68 Gulf of Mexico	Jackup	320	30000
	Penrod 69 Middle East	Jackup	320	30000
	Penrod 80 North Sea	Jackup	210	25000
	Penrod 81 North Sea	Jackup	210	25000
	Penrod 82 Gulf of Mexico	Jackup	300	25000
	Penrod 83 Gulf of Mexico	Jackup	250	25000
	Penrod 84 Gulf of Mexico	Jackup	250	25000
	Penrod 85 North Sea	Jackup	300	25000
	Penrod 86 Gulf of Mexico	Jackup	250	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Penrod 87 Gulf of Mexico	Jackup	300	25000
	Penrod 88 Gulf of Mexico	Jackup	250	25000
	Penrod 89 Gulf of Mexico	Jackup	250	25000
	Penrod 90 Gulf of Mexico	Jackup	250	25000
	Penrod 91 Gulf of Mexico	Jackup	250	25000
	Penrod 92 North Sea	Jackup	220	25000
	Penrod 93 Middle East	Jackup	250	25000
	Penrod 95 Middle East	Jackup	246	25000
	Penrod 96 Gulf of Mexico	Jackup	250	25000
	Penrod 97 Gulf of Mexico	Jackup	250	25000
	Penrod 98 Gulf of Mexico	Jackup	250	25000
	Penrod 99 Gulf of Mexico	Jackup	150	25000
	Prober 94 Gulf of Mexico	Jackup	246	25000
	Penrod 70 Gulf of Mexico	Semisubmersible	600	30000
	Penrod 71 South America	Semisubmersible	1000	30000
	Penrod 72 Gulf of Mexico	Semisubmersible	2000	30000
	Penrod 73 Gulf of Mexico	Semisubmersible	1500	30000
	Penrod 74 Gulf of Mexico	Semisubmersible	2000	30000
	Penrod 75 Gulf of Mexico	Semisubmersible	2000	30000
	Penrod 76 Gulf of Mexico	Semisubmersible	2500	30000
	Penrod 77 Gulf of Mexico	Semisubmersible	2500	30000
	Penrod 78 Gulf of Mexico	Semisubmersible	3000	30000
	Penrod 50 Gulf of Mexico	Submersible	50	25000
	Penrod 51 Gulf of Mexico	Submersible	60	25000
Penrod Portal Drilling	Portal 201 Gulf of Mexico	Submersible	85	30000
	Portal 202 Gulf of Mexico	Submersible	85	30000
	Portal 203 Gulf of Mexico	Submersible	85	30000
Perforadora	Reforma Central America	Drill Barge	600	25000
	Revolucion Central America	Drill Barge	600	25000
	Jalapa Central America	Jackup	300	25000
	Zacateca Central America	Jackup	300	25000
Permargo Chichen Sa	Chichen Itza Southern Asia	Jackup	300	30000
Permargo International Sa (Pisa)	Uxmal Southern Asia	Jackup	300	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Petrobaltic	Petrobaltic I Eastern Europe	Jackup	295	19685
Petrobras	Petrobras II South America	Drillship	984	20000
	Petrobras I South America	Jackup	100	12000
	Petrobras III South America	Jackup	320	25000
	Petrobras IV South America	Jackup	110	11500
	Petrobras V South America	Jackup	250	25000
	Petrobras VI West Africa	Jackup	300	25000
	Petrobras XI South America	Jackup	300	25000
	Petrobras IX South America	Semisubmersible	1200	20000
	Petrobras X South America	Semisubmersible	1200	25000
	Petrobras XII South America	Semisubmersible	1200	20000
	Petrobras XIII South America	Semisubmersible	1200	25000
	Petrobras Xiv South America	Semisubmersible	1200	25000
	Petrobras Xv South America	Semisubmersible	1200	30000
	Petrobras Xvi South America	Semisubmersible	1200	23000
	Petrobras Xvii South America	Semisubmersible	1200	23000
Petrobras/Gepem	Petrobras VII South America	Semisubmersible	660	25000
Petromar	Atlas Eastern Europe	Jackup	300	19680
	Fortuna Eastern Europe	Jackup	300	19680
	Gloria Eastern Europe	Jackup	300	19686
	Orizont-1 Eastern Europe	Jackup	300	25000
	Prometeu Eastern Europe	Jackup	300	25000
Phoenix Seadrill Phoenix Mgmt Corp	Mr Ric Gulf of Mexico	Jackup	100	20000
Polar Frontier (Joint Venture) Sonat	Polar Pioneer North Sea	Semisubmersible	1500	21000
Pool	Pool 50 Gulf of Mexico	Jackup	80	10000
	Pool 53 Gulf of Mexico	Jackup	90	12000
	Pool 54 Gulf of Mexico	Jackup	90	12000
	Pool 55 Gulf of Mexico	Jackup	90	12000
Pool Pool Arabia	Pool 142 Middle East	Jackup	150	12000
	Pool 143 Middle East	Jackup	150	12000
	Pool 144 Middle East	Jackup	150	12000
	Pool 145 Middle East	Jackup	150	12000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Protech	e W Thornton Middle East	Drillship	600	25000
Protexa	Azteca Southern Asia	Jackup	300	25000
	Maya Central America	Jackup	300	25000
	Nahuatl Central America	Jackup	250	25000
	Totonaca Central America	Jackup	250	20000
	Zapoteca Central America	Jackup	250	20000
Pt Patra	Baruna II Southeast Asia	Jackup	140	12000
	Semar Southeast Asia	Jackup	140	12000
Qgpc	Dana Middle East	Jackup	250	20000
Reading & Bates	Douglas Carver Western Europe	Drillship	600	2500
	C e Thornton West Africa	Jackup	300	25000
	Chris Seger Southeast Asia	Jackup	256	20000
	D K Mcintosh Southeast Asia	Jackup	250	20000
	D R Stewart Southern Asia	Jackup	300	25000
	F G Mclintock North Sea	Jackup	300	25000
	George H Galloway Caribbean	Jackup	300	25000
	Harvey H Ward Southeast Asia	Jackup	300	25000
	J W Mclean Southern Asia	Jackup	225	20000
	Mr Jack Mediterranean	Jackup	300	25000
	Randolph Yost Gulf of Mexico	Jackup	300	25000
	Roger W Mowell Mediterranean	Jackup	300	25000
	Ron Tappmeyer North Sea	Jackup	300	25000
	W B Tyson Mediterranean	Jackup	300	25000
Reading & Bates	W T Adams Middle East	Jackup	355	25000
	Jim Cunningham Far East	Semisubmersible	1500	25000
	M G Hulme Jr North Sea	Semisubmersible	2200	25000
	Zane Barnes Gulf of Mexico	Semisubmersible	6000	30000
Remm	Cowrie I West Africa	Jackup	55	25000
Ross	Ross Isle North Sea	Semisubmersible	1500	25000
	Ross Rig North Sea	Semisubmersible	1650	25000
Rowan	Arch Rowan North Sea	Jackup	300	25000
	Cecil Provine North Sea	Jackup	300	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Charles Rowan North Sea	Jackup	300	25000
	Gilbert Rowe North Sea	Jackup	300	25000
	Rowan Alaska Gulf of Mexico	Jackup	300	30000
	Rowan California North Sea	Jackup	300	30000
	Rowan Fort Worth Gulf of Mexico	Jackup	300	25000
	Rowan Gorilla I Canadian East Coast	Jackup	328	25000
	Rowan Gorilla II North Sea	Jackup	328	25000
	Rowan Gorilla III Gulf of Mexico	Jackup	400	30000
	Rowan Halifax North Sea	Jackup	300	25000
	Rowan Juneau Gulf of Mexico	Jackup	350	25000
	Rowan Louisiana Gulf of Mexico	Jackup	350	30000
	Rowan Middletown Gulf of Mexico	Jackup	300	30000
	Rowan Odessa Gulf of Mexico	Jackup	300	30000
Rowan	Rowan Paris Gulf of Mexico	Jackup	300	30000
	Rowan Midland Gulf of Mexico	Semisubmersible	600	25000
Rowan International	Rowan Anchorage Gulf of Mexico	Jackup	250	20000
	Rowan Gorilla IV Gulf of Mexico	Jackup	450	0
	Rowan Houston Gulf of Mexico	Jackup	225	20000
	Rowan New Orleans Gulf of Mexico	Jackup	225	20000
	Rowan Texas Gulf of Mexico	Jackup	250	20000
Royal Bank of Canada	Robert N Haskin Gulf of Mexico	Jackup	100	20000
Saga Panocean	Amazone West Africa	Jackup	165	10000
Saipem	Saipem Due Mediterranean	Drillship	1500	25000
	Perro Negro Mediterranean	Jackup	140	21000
	Perro Negro 2 Mediterranean	Jackup	300	21000
	Perro Negro 3 Mediterranean	Jackup	300	20000
Saipem	Perro Negro 4 Middle East	Jackup	150	16000
	Perro Negro 5 Mediterranean	Jackup	300	25000
	Scarabeo 2 Mediterranean	Semisubmersible	650	25000
	Scarabeo 3 Mediterranean	Semisubmersible	1300	30000
	Scarabeo 4 Gulf of Mexico	Semisubmersible	1600	20000
Santa Fe	Orinico I South America	Drill Barge	30	25000
	Reina Del Lago	Drill Barge	100	14000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	South America			
	Rey Del Lago	Drill Barge	100	14000
	South America			
	Britannia	Jackup	100	30000
	North Sea			
	Galveston Key	Jackup	300	30000
	North Sea			
	Key Bermuda	Jackup	200	25000
	West Africa			
	Key Gibraltar	Jackup	300	25000
	Middle East			
	Key Hawaii	Jackup	300	25000
	Us West Coast			
	Key Largo	Jackup	300	25000
	West Africa			
	Key Manhattan	Jackup	300	25000
	Gulf of Mexico			
	Key Singapore	Jackup	300	25000
	Southeast Asia			
	Key Victoria	Jackup	260	25000
	West Africa			
	Santa Fe 103	Jackup	250	20000
	Southeast Asia			
	Santa Fe 105	Jackup	250	20000
	Middle East			
	Santa Fe 124	Jackup	250	20000
	Middle East			
	Santa Fe 127	Jackup	250	20000
	Southeast Asia			
	Santa Fe 134	Jackup	250	20000
	Southeast Asia			
	Santa Fe 136	Jackup	250	20000
	Middle East			
	Santa Fe 141	Jackup	250	20000
	Middle East			
	Santa Fe Explorer	Jackup	160	15000
	Southeast Asia			
	Aleutian Key	Semisubmersible	3000	25000
	Gulf of Mexico			
	Bluewater 3	Semisubmersible	600	25000
	Caribbean			
	Bluewater 4	Semisubmersible	1500	20000
	Gulf of Mexico			
	Choctaw I	Semisubmersible	800	20000
	Gulf of Mexico			
	Santa Fe 135	Semisubmersible	1500	25000
	Western Europe			
	Santa Fe 140	Semisubmersible	1500	25000
	Western Europe			
	Santa Fe Mariner I	Semisubmersible	600	20000
	Middle East			
	Santa Fe Mariner II	Semisubmersible	600	20000
	Mediterranean			
	Santa Fe Mariner III	Semisubmersible	600	20000
	Gulf of Mexico			
	Bluewater 2	Submersible	55	25000
	Gulf of Mexico			
Santa Fe South Seas Drilling Co	Southern Cross	Semisubmersible	1500	20000
	Oceania			
Savage	Ponca	Jackup	150	20000
	Gulf of Mexico			
Scan Drilling	Scan Bay	Jackup	250	20000
	Middle East			
Schahin Cury	North Star I	Jackup	200	20000
	South America			
Scotdril Reading & Bates	Sovereign Explorer	Semisubmersible	2000	25000
	Western Europe			

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Sds Drilling	Vildkat North Sea	Semisubmersible	1000	20000
	Vinland Canadian East Coast	Semisubmersible	1500	25000
	Vinni North Sea	Semisubmersible	1500	25000
Sea Drlg Netherlands Antilles	Sedneth 201 Middle East	Jackup	200	20000
	Sedneth 202 Middle East	Jackup	200	20000
	Sedneth Luanda West Africa	Jackup	200	25000
Sea Drlg Netherlands Bv	Sedneth 701 North Sea	Semisubmersible	2000	25000
Seacrest Unocal	Seacrest Southeast Asia	Drillship	1000	25000
Seattle First Nat Bnk	Mr Demp Gulf of Mexico	Jackup	250	25000
Sedco Forex	Grand Large Southeast Asia	Drill Barge	250	21000
	Searex II West Africa	Drill Barge	350	25000
	Sedco 445 Southeast Asia	Drillship	3000	20000
	Sedco 472 South America	Drillship	6000	25000
	Sedco 160 Middle East	Jackup	160	20000
	Sedco 251 West Africa	Jackup	250	20000
	Sedco 252 Southern Asia	Jackup	250	20000
	Sedco 253 Western Europe	Jackup	250	20000
	Trident II Southeast Asia	Jackup	350	25000
	Trident III Middle East	Jackup	300	25000
	Trident IV West Africa	Jackup	300	25000
	Trident IX West Africa	Jackup	400	21000
	Trident V Middle East	Jackup	150	21000
	Trident VI Middle East	Jackup	300	18000
	Trident VII Southeast Asia	Jackup	132	21000
	Trident VIII West Africa	Jackup	300	21000
	Trident X North Sea	Jackup	300	25000
	Trident XI North Sea	Jackup	300	25000
	Drill Star North Sea	Semisubmersible	1500	25000
	Pentagone 81 South America	Semisubmersible	660	21000
	Pentagone 82 Gulf of Mexico	Semisubmersible	1200	25000
	Pentagone 84 North Sea	Semisubmersible	1050	25000
	Sedco 135D South America	Semisubmersible	600	25000
	Sedco 135F South America	Semisubmersible	600	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Sedco 600 Far East	Semisubmersible	1000	25000
	Sedco 700 North Sea	Semisubmersible	2000	25000
	Sedco 702 Gulf of Mexico	Semisubmersible	2000	25000
	Sedco 703 North Sea	Semisubmersible	2000	25000
	Sedco 704 North Sea	Semisubmersible	2000	25000
	Sedco 706 Gulf of Mexico	Semisubmersible	1500	20000
	Sedco 708 Far East	Semisubmersible	1500	25000
	Sedco H Mediterranean	Semisubmersible	800	25000
	Sedco J West Africa	Semisubmersible	800	25000
	Sedco K Southern Africa	Semisubmersible	800	25000
	Sedco Staflo South America	Semisubmersible	600	20000
	Sedco 709 Canadian East Coast	Semisubmersible	6000	25000
Sedco Forex/Bp Underseas Drilling	Sedco/BP 471 Central America	Drillship	27000	30000
Sedco Forex/Bp Sedco Forex	Sedco/BP 711 North Sea	Semisubmersible	2000	25000
Sedco Forex/Occidental Sedco Forex	Sedco 602 Far East	Semisubmersible	600	25000
Sedco Forex/Petrocan Sedco Forex	Sedco 710 Canadian East Coast	Semisubmersible	5000	30000
Sedco Forex/Phillips Sedco Forex	Sedco 712 Us West Coast	Semisubmersible	1500	25000
Sedco Forex/Ranger Sedco Forex	Sedco 714 North Sea	Semisubmersible	1500	25000
Sedco Forex/Shell	Sedco 709 Canadian East Coast	Semisubmersible	6000	25000
Sedco Forex/Union Texas Sedco Forex	Sedco 601 Gulf of Mexico	Semisubmersible	800	25000
Shell Uk	Stadrill North Sea	Semisubmersible	800	25000
Si Construction	Glomar Main Pass II Gulf of Mexico	Jackup	300	25000
Smedvig	West Vanguard North Sea	Semisubmersible	1500	25000
	West Venture North Sea	Semisubmersible	1200	25000
	West Vision Far East	Semisubmersible	0	0
Sonat	Discoverer 511 South America	Drillship	2000	20000
	Discoverer 534 Gulf of Mexico	Drillship	3000	20000
	Discoverer III Southeast Asia	Drillship	600	20000
	Discoverer Seven Seas Gulf of Mexico	Drillship	7500	25000
	Interocean Discoverer South America	Drillship	1500	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Df-80 Gulf of Mexico	Jackup	370	20000
	Df-84 Gulf of Mexico	Jackup	250	20000
	Df-85 Gulf of Mexico	Jackup	200	20000
	Df-86 Gulf of Mexico	Jackup	200	20000
	Df-87 Gulf of Mexico	Jackup	300	25000
	Hustler Middle East	Jackup	90	10000
	Offshore Antares Middle East	Jackup	115	15000
	Offshore Aquarius Middle East	Jackup	250	20000
	Offshore Bahram Middle East	Jackup	200	20000
	Offshore Comet Middle East	Jackup	225	20000
	Offshore Jupiter Middle East	Jackup	130	16000
	Offshore Mercury Middle East	Jackup	250	20000
	Offshore Pegasus Gulf of Mexico	Jackup	125	16000
	Offshore Taurus Gulf of Mexico	Jackup	250	20000
	Chris Chenery South America	Semisubmersible	660	20000
	Df-95 Southern Asia	Semisubmersible	1000	25000
	Df-96 North Sea	Semisubmersible	1200	25000
	Df-97 North Sea	Semisubmersible	1200	2500
	Henry Goodrich North Sea	Semisubmersible	10000	30000
	John Shaw Gulf of Mexico	Semisubmersible	1500	25000
	Df-76 Gulf of Mexico	Submersible	80	20000
	Df-77 Gulf of Mexico	Submersible	85	25000
Sonat National Offshore Contractors	Jubilee Middle East	Jackup	225	20000
Stena Dyvi Offshore A/S	Dyvi Stena North Sea	Semisubmersible	2000	30000
Teledyne	Teledyne 16 Gulf of Mexico	Jackup	250	25000
	Teledyne 17 Gulf of Mexico	Jackup	250	25000
	Teledyne 18 Gulf of Mexico	Jackup	250	25000
	Teledyne 19 Gulf of Mexico	Jackup	250	25000
	Teledyne 20 Gulf of Mexico	Jackup	250	25000
	Movible 2 Gulf of Mexico	Submersible	50	20000
Transworld	Transworld 59 Gulf of Mexico	Jackup	125	20000
	Transworld 62 Gulf of Mexico	Jackup	300	25000
	Transworld 63 Gulf of Mexico	Jackup	250	25000
	Transworld 64 Gulf of Mexico	Jackup	300	25000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Transworld 71 Gulf of Mexico	Jackup	250	25000
	Transworld 74 Western Europe	Jackup	400	30000
	Transworld 58 North Sea	Semisubmersible	600	20000
	Transworld 61 South America	Semisubmersible	600	20000
	Transworld 44 Gulf of Mexico	Submersible	40	18000
	Transworld 47 Gulf of Mexico	Submersible	70	20000
	Transworld 54 Gulf of Mexico	Submersible	175	20000
	Transworld 65 Gulf of Mexico	Submersible	70	25000
	Transworld 68 Gulf of Mexico	Submersible	100	25000
	Transworld 69 Gulf of Mexico	Submersible	100	25000
	Transworld 70 Gulf of Mexico	Submersible	100	25000
	Transworld 72 Gulf of Mexico	Submersible	100	25000
	Transworld 73 Gulf of Mexico	Submersible	100	25000
Transworld Transocean	Transocean IV North Sea	Jackup	160	25000
	Transocean V Middle East	Jackup	300	25000
	Transocean VI North Sea	Jackup	300	25000
	Transocean VII North Sea	Jackup	300	25000
Trigon Neddrill	Neddrill Trigon North Sea	Jackup	360	25000
Trinidad Gulf Drilling	Robert M Womack Gulf of Mexico	Jackup	100	20000
Tropic	Tainaron South America	Drillship	1000	30000
Unap	Amaralina South America	Jackup	275	20000
Underwater Gas Developers	Telesis Great Lakes	Great Lakes Barge	210	5000
	Timesaver II Great Lakes	Jackup	80	3000
USSR	26Th Communist Party Eastern Europe	Jackup	200	20000
	28Th of April Eastern Europe	Jackup	250	30000
	40 Years of Victory Eastern Europe	Jackup	295	19685
	60 Years of October Eastern Europe	Jackup	200	20000
	Aspheron Eastern Europe	Jackup	90	5900
	Azerbaijan Eastern Europe	Jackup	66	12000
	Baku Eastern Europe	Jackup	200	20000
	Chazar Eastern Europe	Jackup	300	20000
	Khazar Eastern Europe	Jackup	200	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
	Sivash Eastern Europe	Jackup	200	20000
	Caspmormeft Eastern Europe	Semisubmersible	656	19686
	Shelf 1 Eastern Europe	Semisubmersible	600	20000
	Shelf 2 Eastern Europe	Semisubmersible	656	19685
	Shelf 3 Eastern Europe	Semisubmersible	1000	22966
	Shelf 4 Eastern Europe	Semisubmersible	656	19685
	Shelf 5 Eastern Europe	Semisubmersible	656	19685
	Shelf 6 Far East	Semisubmersible	656	19685
USSR Arctic Offshore O&g	Victor Muravelenko Eastern Europe	Drillship	984	21320
USSR Sudoimport	Valentin Shashin Eastern Europe	Drillship	1000	21500
	Kolskaja Eastern Europe	Jackup	328	21327
	Oxa Far East	Jackup	210	18000
	Sakhalinskaya Far East	Jackup	328	21327
Vietsovpetro Vietsovpetro/Sudoimport	Ekhabi Southeast Asia	Jackup	300	20000
Wadi Techfor-Cosifor	Nengue Sika West Africa	Jackup	300	20000
Wcb International Odfjell Drilling	Petrolia Mediterranean	Semisubmersible	1000	20000
Western Oceanic	Nike I Gulf of Mexico	Jackup	150	20000
	Western Apollo I North Sea	Jackup	300	20000
	Western Apollo II North Sea	Jackup	300	20000
	Western Apollo III Middle East	Jackup	300	2000
	Western Apollo IV Middle East	Jackup	300	20000
	Western Delta Gulf of Mexico	Jackup	173	15000
	Western Polaris I West Africa	Jackup	250	20000
	Western Polaris II West Africa	Jackup	250	20000
	Western Triton I Middle East	Jackup	250	20000
	Western Triton II South America	Jackup	250	20000
	Western Triton III Gulf of Mexico	Jackup	250	20000
	Western Triton IV Gulf of Mexico	Jackup	250	20000
	Western Pacesetter IV North Sea	Semisubmersible	1500	25000
Western Oceanic/E45on Western Oceanic	Alaskan Star Gulf of Mexico	Semisubmersible	1500	30000
Western Selcast Atwood Oceanics	Regional Endeavour Southeast Asia	Drillship	1500	20000

Owner/ Management	Rig Name/ location	Type	Rated Wtr. Depth, Ft	Rated Drg. Depth, Ft
Wilhelmsen	Treasure Hunter North Sea	Semisubmersible	1250	25000
	Treasure Saga North Sea	Semisubmersible	1500	25000
	Treasure Scout North Sea	Semisubmersible	1500	25000
	Treasure Seeker North Sea	Semisubmersible	1250	25000
	Treasure Swan North Sea	Semisubmersible	600	25000
Ypf	General Enrique Mosconi South America	Semisubmersible	600	20000
Zapata	Zapata Trader Southeast Asia	Drillship	600	20000
	Bonito II Southern Asia	Jackup	300	25000
	Miss Kitty Southern Asia	Jackup	300	25000
	Zapata Bonanza North Sea	Jackup	300	25000
Zapata	Zapata Heritage Gulf of Mexico	Jackup	250	20000
	Zapata Nordic North Sea	Jackup	300	25000
	Zapata Scotian North Sea	Jackup	200	25000
	Zapata Sovereign Southeast Asia	Jackup	250	20000
	Zapata Arctic Oceania	Semisubmersible	2000	25000
	Zapata Concord Gulf of Mexico	Semisubmersible	2000	25000
	Zapata Saratoga Gulf of Mexico	Semisubmersible	2000	25000
	Zapata Ugland North Sea	Semisubmersible	700	25000
	Zapata Whittington Gulf of Mexico	Semisubmersible	1300	25000
	Zapata Yorktown Gulf of Mexico	Semisubmersible	2000	25000
Zapata Etesco	Zapata Lexington South America	Semisubmersible	2000	25000
Zapata Irgens Larsen	Zapata Neptune Gulf of Mexico	Semisubmersible	1500	25000

OFFSHORE INDEX
1986

Authors	Issue	Page
Abbott, Dave		
Current seismic rates at 50% of 1981 levels	Aug.	88
Azpiazu, W. (co-author)		
Subsea completion uses deepwater tree	Aug.	31
Booth, Derrick		
Petroleum technology - past, present, and future	Dec.	43
Burke, Robert G.		
Design is easy; obtaining a consensus isn't	Jan.	9
Weather outlook becomes a monthly feature	Feb.	11
Company mergers dominate this year's boat survey	Mar.	9
Laughter proves to be the best medicine	Apr.	9
Climbing out on a limb where the view is clearer	May	11
Norwegian platform test wins Offshore award	June	9
Changes in marketplace may herald better times ahead	July	9
Strict rules set for drilling muds in Gulf	Aug.	11
The move to automate offshore platforms	Sept.	9
Computer data helps analyze causes for drilling doldrums	Oct.	9
Drilling decline turning up?	Nov.	9
The game isn't what it once was	Dec.	9
Bourgoyne, Adam T. (co-author)		
Integration of MWD well control technologies	Sept.	49
Cornitius, Tim		
Rig use increase foreseen	Feb.	33
Cortez, A. J. (co-author)		
Largest production unit installed off Nigeria	Aug.	46
Delepine, Yves		
Development linked with fixed mooring	Nov.	49
Desbrandes, Robert (co-author)		
Integration of MWD well control technologies	Sept.	49
Eppley, Donald R. (co-author)		
Largest production unit installed off Nigeria	Aug.	46
Gaspar, George J.		
Saudis target non-OPEC oil	May	61
Gaucher, Dennis E. (co-author)		
ater quality monitor studied	June	46
Gooderham, R.E.		
Norway - disappointment of 3	Apr.	8
could see end of giants	May	141
Hazlegrove, B. M. (co-author)		
Thermal insulation for subsea pipelines	July	51
Healey, A. J. (co-author)		
Thermal insulation for subsea pipelines	July	51
Houston, Mark		
Strategies improve seismic efficiency	July	42
Jakubowicz, Helmut		
Each 3-D survey unique technology	July	35
Jones, Maurice (Mo)		
Understanding new EPA mud rules	Sept.	45
Jones, R. D. (co-author)		
Controlling hydrates in deep water	July	27
Kaplan, K. M. (co-author)		
Thermal insulation for subsea pipelines	July	51
Kelly, Tom (co-author)		
Subsea equipment - ROV marriage near		32
LeBlanc, Leonard A.		
Bullwinkle technology	Mar.	49
Crisis overload: too much data, too little time	Sept.	38
Finland - firms expand into production, subsea, ice systems	Apr.	123
Gulf of Mexico - special report	Feb.	38
Sweden - new technologies solve traditional problems	Apr.	53
Lewis, Ralph		
Foreign policy reversal	Feb.	54
Luppens, J. C. (co-author)		
Water quality monitor studied	June	46
March, Frank A.		
Foam fenders enable successful TLP mating	Aug.	84
Masson, Kerry		
Coring through hull helps avoid punchthrough	Aug.	42
Milner, Bart		
Denmark - Danes networking existing, new fields	May	131
Gas sale brightens North Sea picture	Aug.	49
Gas supply surges	Apr.	43
North Sea pipeline jolts industry awake	July	48
UK exports blooming	May	159
Unfreezing the Arctic: a matter of economics	Oct.	41
Oliverira, D. (co-author)		
Subsea completion uses deepwater tree	Aug.	31
Peereboom, Hans		
Tanker loading - designing for subsea	Dec.	56
Ramsey, Dick (co-author)		
Subsea equipment - ROV marriage near	June	32
Records, L. Russell		
Computers with brains	Feb.	53
Redden, Jim		
Canada under pressure	May	139
Drugs offshore	Jan.	31
Platform removal becomes international issue	Nov.	27
Sherman, Jim (co-author)		
Controlling hydrates in deep water	July	27
Tanner, Roger		
Day rates Catch-22	Feb.	36
Taylor, Edwin		
Brazil pumps $7 billion into Campos offshore fields	Nov.	57
Taylor, William		
Modular BOP stack goes compact	Aug.	44
Tucker, Phillip (co-author)		
Water quality monitor studied	June	46

Titles	Issue	Page
Brazil pumps $7 billion into Campos offshore fields by Edwin Taylor	Nov.	57
Bullwinkle technology by Leonard A. LeBlanc	Mar.	49
Canada under pressure by Jim Redden	May	169
Changes in marketplace may herald better times ahead by Robert G. Burke (Speaking Out)	July	9
Company mergers dominate this year's boat survey by Robert G. Burke (Speaking Out)	Mar.	9
Climbing out on a limb where the view is clearer by Robert G. Burke (Speaking Out)	May	11
Computer data helps analyze causes for drilling doldrums by Robert G. Burke (Speaking Out)	Oct.	9
Computers with brains by L. Russell Records	Feb.	53
Controlling hydrates in deep water by R. D. Jones and Jim Sherman	July	27
Coring through hull helps avoid punchthrough by Kerry Masson	Aug.	42
Crisis overload: too much data, too little time by Leonard A. LeBlanc	Sept.	38
Current seismic rates at 50% of 1981 levels by Dave Abbott Aug.	88	
Day rates Catch-22 by Roger Tanner	Feb.	36
Denmark - Danes networking existing, new fields by Bart Milner	May	131
Design is easy; obtaining a consensus isn't by Robert G. Burke (Speaking Out)	Jan.	9
Development linked with fixed mooring by Yves Delepine	Nov.	49
Drilling decline turning up? by Robert G. Burke (Speaking Out)	Nov.	9
Drugs offshore by Jim Redden	Jan.	31
Each 3-D survey unique technology by Helmut Jakubowicz	July	35
Finland - Finns expand into production, subsea, ice management by Leonard A. LeBlanc	Apr.	123
Foam fenders enable successful TLP mating by Frank A. March	Aug.	84
Foreign policy reversal by Ralph Lewis	Feb.	54
The game isn't what it once was by Robert G. Burke (Speaking Out)	Dec.	9
Gas sale brightens North Sea picture by Bart Milner	Aug.	49
Gas supply surges by Bart Milner	Apr.	43
Gulf of Mexico - special report by Leonard A. LeBlanc	Feb.	38
Integration of MWD well control technologies by Adam T. Bourgoyne and Robert Desbrandes	Sept.	49
Largest production unit installed off Nigeria by A. J. Cortez and Donald R. Eppley	Aug.	46
Laughter proves to be the best medicine by Robert G. Burke (Speaking Out)	Apr.	9
Modular BOP stack goes compact by William Taylor	Aug.	44
The move to automate offshore platforms by Robert G. Burke (Speaking Out)	Sept.	9
North Sea pipeline jolts industry awake by Bart Milner	July	48
Norway - disappointment of 3 could see end of giants by R. E. Gooderham	Apr. May	8 141
Norwegian platform test wins Offshore award by Robert G. Burke (Speaking Out)	June	9
Petroleum technology - past, present and future by Derrick Booth	Dec.	43
Platform removal becomes international issue by Jim Redden	Nov.	27
Rig use increase foreseen by Tim Cornitius	Feb.	33
Saudis target non-OPEC oil by George J. Gaspar	May	61
Strategies improve seismic efficiency by Mark Houston	July	42
Strict rules set for drilling muds in Gulf by Robert G. Burke (Speaking Out)	Aug.	11
Subsea completion uses deepwater tree by W. Azpiazu and D. Oliverira	Aug.	31
Subsea equipment -ROV marriage near by Dick Ramsey and Tom Kelly	June	32
Sweden - new technologies solve traditional problems offshore by Leonard A. LeBlanc	Apr.	53

Titles	Issue	Page
Tanker loading - designing for subsea by Hans Peereboom	Dec.	56
Thermal insulation for subsea pipelines by B. M. Hazlegrove, A. J. Healey and K. M. Kaplan	July	51
UK exports blooming by Bart Milner	May	159
Understanding new EPA mud rules by Maurice (Mo) Jones	Sept.	45
Unfreezing the Arctic: a matter of economics by Bart Milner	Oct.	41
Water quality monitor studied by Dennis E. Gaucher, J. C. Luppens and Phillip Tucker	June	46
Weather outlook becomes a monthly feature by Robert G. Burke (Speaking Out)	Feb.	11

Subjects	Issue	Page
A		
ABU DHABI		
Japan's United Petroleum Dev. to produce next year	Oct.	12
Two major projects offshore described	May	112
ACB		
French company designs subsea habitat	Feb.	23
ACB (UK)		
Recent export sales of BOP, risers	May	162
ACCIDENTS		
Cause rise in insurance premiums for offshore rigs	Dec.	15
New evidence on West Vanguard disaster	June	15
New facts found in model study of Ocean Ranger	July	15
ACL-FILCO		
Changes name to ACL Technologies, Inc.	June	57
ACMP		
Robot welding jacket nodes	Aug.	21
ACOUSTIC TECHNOLOGY LTD.		
Has Ferranti contract for SWOPS vessel	Sept.	55
ADVANCED PRODUCTION TECHNOLOGY		
Well data systems eliminate cables	Mar.	23
ADVANCED TECHNOLOGY		
Regular feature by Leonard A. LeBlanc Jan. p. 23; Feb. p. 25; Mar p. 23; Apr. p. 23, May p. 25, Jun p. 23; Jul. p. 21; Aug. p. 23; Sep p. 21; Oct. p. 21; Nov. p. 21; Dec. p. 23		
ADVANCED UNDERWATER TECHNOLOGY (Sweden)		
Simulator tests diver equipment	Apr.	96
AEG (UK) LTD.		
Has Shell/Esso contract in Eider field	Sept.	58
AFRICA		
Agip begins drilling in Nigerian area	Aug.	14
Exploration moves to east coast	May	104
Madagascar, Nigeria offshore activity	May	104
Saga to resume operating Seme field Benin	Aug.	14
AGIP S.P.A.		
Marginal field terminal with IMODCO & Snamprogretti	Feb.	63
AIB (Sweden)		
Cutting weight on offshore structures	Apr.	60
AKER ENGINEERING		
Aker producer driller uses closed pontoons	May	146
To convert semi to floater for Petrobras	Aug.	105
ALABAMA		
Conoco spuds 2nd deepest Gulf of Mexico well	Oct.	128
Shell Offshore and Amoco have gas find Mobile Bay area	July	13
Standard Oil Production Co. has natural gas find	Aug.	13
ALASKA		
Boeing 234s successful in Navarin Basin	Mar.	61
Endicott field on schedule as first producer	May	99
Equipment en route from Louisiana to Endicott field	July	11
MacKenzie Delta oil potential	Oct.	42
Map - Endicott field	July	11
Shell's Seal Island may be second producer	May	99
Standard Oil is operator for Endicott field	July	11
Whales said to be in danger from drilling	Oct.	5
ALIMARK (Sweden)		
Rack and pinion lift designed	Apr.	85
Track lift, crane replace platform flare tip	May	129
ALLSEAS ENGINEERING B.V.		
Mechanical pipe trencher to work in North Sea	July	56
ALPHA EQUIPMENT SERVICES (NORTH) LTD.		
Acquires offshore division of Dowsett Prepakt Ltd.	May	180
AMAULIGAK		
Discovery in Beaufort Sea is on schedule	Apr.	167
AMERADA HESS DEVELOPMENT		
Issues contract to National Supply for North Sea equipment	Aug.	105
AMERICAN BUREAU OF SHIPPING		
Issues guide for laying-up rigs	Dec.	59
Opens office in Houston	Feb.	60
Stability study of offshore mobile rigs	Nov.	15
AMERICAN LEWA CO.		
Moves to Holliston, MA	June	57
ANGOLA		
Extends bid invitations to September 1	Aug.	6
Mitsubishi Petroleum & Taiya Oil working offshore	Oct.	13
Texaco group has oil find in wildcat off NW coast	Nov.	13

Subjects	Issue	Page
Texaco has oil find Sulele South-1	Dec.	13
U.S. questions Gulf's Angola stake	Mar.	54
ANR PIPELINE CO.		
Terminates gas contract with Mobil Oil	Sept.	6
ANTARCTIC		
Technology may help develop area	May	13
AQUATA PAINT AB (Sweden)		
Underwater coating protects concrete	Apr.	90
ARAB STATES		
Winning war to reduce competition in oil industry	July	5
ARABIAN GULF		
War zone transit hazard to vessels	Aug.	38
ARCTIC		
Concrete structures proposed by Norwegians	Oct.	46
Difficult decisions to be made by U.S.S.R.	Oct.	41
Polar frontiers challenge oil explorers	Oct.	49
ARGENTINA		
Total and Shell to produce offshore	May	97
ARTIFICIAL INTELLIGENCE		
Need for expert systems on large platforms	Sept.	38
ASEA (Sweden)		
Crack inspection device operates remotely	Apr.	58
In R&D agreement with GECO	May	180
Manipulator arm has sensory feedback	Apr.	85
ASEA PLAST (Sweden)		
Composites improve tank's safety, weight	Apr.	64
ASIA		
SEE ALSO SOUTHEAST ASIA		
Arco plans major development	May	106
Drilling on upswing	Jan.	41
Indonesia in Catch-22 OPEC position	May	106
Pacific region shows continued growth	Nov.	6
SE Asian investment parallels that in U.S. Gulf	Jan.	41
ATKINS OIL & GAS ENGINEERING		
Cost forecaster now available	Apr.	174
ATLANTIA ENGINEERING		
Seahorse platform for natural gas production	Mar.	52
ATLAS		
Danish water system uses separator	May	138
AUSTRALIA		
SEE ALSO WEST AUSTRALIA		
BHP has successful flow in Challis field	Dec.	13
Bond Corp.'s Harriet field production	Mar.	12
Bond Corp. re-opens tenders for Jabiru lease	July	13
Jabiru, Timor Sea work described	Jan.	52
Map	Sept.	11
Map -Gippsland Basin	Nov.	11
Must double output to meet needs	Mar.	6
Offshore exploration wells 1979-1985	May	109
Recent offshore activity	Jan.	42
Review of current offshore activity	Sept.	11
Timor Sea has most interest	May	109
Woodside Petroleum spuds well on NW Shelf	June	13
Woodside says NW Shelf platform is sound	Dec.	13
Workers take over North Rankin gas platform	Oct.	13
AVESTA PRODUCTS AB (Sweden)		
Stainless seawater piping on 20 North Sea units	Apr.	80
AVONDALE OFFSHORE		
To build seven new Gulf of Mexico platforms	Mar.	19
BAC MANUFACTURING LTD.		
New UK company supplies artificial anodes	Sept.	57
BAHRAIN		
First oil offshore may have been found	May	114
Oil discovery after years of dry wells	Apr.	21
BARDEX HYDRANAUTICS		
Turret downsizing possible with jacks	July	17
BARENTS SEA		
Geoscience Aberdeen completes sample surveys	Nov.	13
BARGE		
DB102 is world's largest (Mitsui)	Feb.	58
BEAUFORT SEA		
Arctic Islands hold big reserves	Oct.	84
BECHTEL		
Researching quick weld qualification system	Aug.	19
BEN LINE (UK)		
Finds current rig market very hard work	May	164
BHP PETROLEUM PTY.		
ROV intervention designed for Jabiru	Aug.	100
BILFINGER & BERGER		
Concrete ring system provides protection	Mar.	19
BLOWOUTS		
Greatest danger to fixed platforms	Nov.	75
BOATS		
SEE ALSO VESSELS		
Buyer-seller relations at low point in boat industry	Jan.	5
BOEING		
Boeing 234 helicopters successful in Navarin basin	Mar.	61
BONNER & MOORE ASSOCIATES		
Acquires Resource Planning Consultants	Dec.	70
BOP		
Cameron Iron Works modular BOP stack goes compact	Aug.	44
Cameron modular T BOP compared to conventional model	Mar.	58
BP NORTH AMERICA INC.		
Files $500 million debt securities	June	57
BRALORNE RESOURCES LTD.		
Sells Supreme Contractors subsidiary	Dec.	70

Subjects	Issue	Page
BRAUN		
Composite terminals workstation alternative	Nov.	73
BRAZIL		
SEE ALSO PETROBRAS		
Aims at international status	Nov.	71
Campos fields, production systems	May	94
Gas reserves boosted by new offshore fields	Nov.	66
Growth in gas reserves 1974-85	Nov.	69
Map - Campos Basin	Nov.	62
Map - gas pipelines	Oct.	11
Natural gas production 1975-86	Nov.	69
Onshore find may preclude deepwater drilling	Dec.	12
Pecten resumes risk contract drilling	May	15
Petrobras in middle of boom	Oct.	1
Petrobras subsea completion uses deepwater tree	Aug.	31
Production of oil and LNG1975-86	Nov.	61
Pumps $7 billion into Campos offshore fields	Nov.	57
ROVs intervene in Gulf, Brazil	June	37
# wells drilled 1974-85	Nov.	61
BRITISH AIRWAYS		
Sells helicopter subsidiary to SDR Helicopters	Dec.	70
BRITISH GAS		
Again tries for supplies abroad	Jan.	19
Encouraging well off Irish coast	July	19
May produce V-field with Conoco	Apr.	21
Smart pig finds work with Statoil	Dec.	21
BRITISH PETROLEUM		
Chops $500 million from exploration budget	Apr.	21
Consortium orders cranes from NEI FAVCO	Feb.	63
Extensive new R&D in Norway	Dec.	21
New Norwegian fields	Dec.	21
SE Asian commitment includes Malaysia, Thailand	Jan.	54
SE Asian investment described	Jan.	41
SWOPS II all-weather, multi-well concept	May	21
Ula field producing 5 months early	Nov.	19
Village Complex in North Sea - active soon	Aug.	54
BRITOIL		
Don field development may be all subsea	Feb.	23
Ettrick may be developed in 1987	Mar.	32
Plans to develop North Sea gas	Mar.	32
BROWN & ROOT		
Interview with Weidler on marine construction	Nov.	36
Sets pipe burial record in North Sea	Nov.	5
BRUNEI		
Recent offshore activity	Jan.	48
BULLWINKLE		
New techniques employed for giant structure	Mar.	49
CABLES		
Power, data cables link Shell's platforms Elly, Eureka	Aug.	99
CAD		
CAD acquisition needs planning	Jan.	23
CAL DIVE INTERNATIONAL		
Has two Pemex rig support contracts	Feb.	6
Vows to survive recession despite problems	Aug.	6
CALENDAR		
Regular feature each issue		
Jan. p. 25; Feb. p. 29; Mar. p. 25; Apr. p. 25; May p. 29; Jun. p. 25; Jul. p. 22; Aug. p. 27; Sep. p. 23; Oct. p. 23; Nov. p. 23; Dec. p. 25		
CALIFORNIA		
Arco Santa Barbara development passes hurdle	May	102
Arco to install four new platforms offshore	Apr.	12
Battelle to study ecosystem	Oct.	6
EPA may let Exxon discharge wildcat wastes	Aug.	14
Exxon to install two platforms offshore	Apr.	12
Interior attacks radio editorial against leases	Oct.	6
Map - active oil reservoirs offshore	Apr.	11
Point Arguello field to produce for Chevron	May	101
Shell plans off Santa Barbara Channel	May	102
Sun Exploration has oil find in Santa Maria Basin	Mar.	11
Sun Exploration has oil find in Santa Barbara Channel	Jan.	13
Union Oil to drill in Santa Maria Basin	May	101
US Navy installs floater in deepwater	Aug.	99
CAMERON IRON WORKS		
Modular BOP stack goes compact	Aug.	44
Modular T BOP compared to conventional model	Mar.	58
blowout preventer reduces stack height	Mar.	58
CAMPOS		
SEE ALSO BRAZIL, PETROBRAS		
Deepwater wildcat has big flow rate	Aug.	32
Marimba producing system under study	Aug.	33
CAN-NAV LTD.		
Radio positioning accuracy improving	May	25
CANADA		
Amauligak discovery in Beaufort Sea on schedule	Apr.	167
Amauligak find in Beaufort Sea described	May	102
Cash flow in petroleum industry up in 1985	Feb.	8
COGLA head reviews rules	May	174
Fickle market hurts Beaufort, East Coast exploration plans	May	169
Fishing pole concept seen as lifesaver	May	176
Gas exports no threat to U.S.	Mar.	5
Gulf Canada has discovery in Amauligak 1-65 well	Mar.	11
Hibernia contracts may be let soon	May	169
Hibernia will need govt support for development	Aug.	15
Interview with M. E. Taschereau, COGLA head	May	174
Mulroney administers new energy plan	May	170
Nuclear sub to work Arctic subsea wells	July	21
Offshore industry stresses development	Feb.	7
Petroleum companies cut budgets drastically	Aug.	6
PIP phased out by Mulroney	May	170
Standards for platforms being prepared	May	173
Three major discoveries by Gulf Canada, Imperial, Dome	Oct.	12
CARIBBEAN		
Rig activity triples	Jan.	64
CATERPILLAR INC.		
To market products of Eisenwerke Reintjes	Nov.	78
CELLULAR NETWORK		
Competition heating up in Gulf of Mexico	Mar.	23
New communication system readied for Gulf	Feb.	46
CHEVRON		
Leader in Gulf platform installations	May	82
Platform Gail sits in Long Beach awaiting ruling	Nov.	5
CHINA		
ACT group has oil gas find in South China Sea	Apr.	13
ACT has interest in Pearl River find	May	109
Amoco signs third contract to drill offshore	Nov.	12
Arco has high gas flows in Yinggehai field	Aug.	15
CNOOC to spend $1 billion on South China Sea gas field	Aug.	15
Hot blocks awarded to Phillips-Shell and Agip-Chevron	Feb.	7
No. 1 petroleum importer from U.S.	May	8
Occidental Eastern discovers oil in South China Sea	June	13
Occidental Eastern has discovery in Pearl River area	May	15
Recent offshore activity	Jan.	48
Texaco begins exploratory drilling in South China Sea	Jan.	13
Texaco signs with CNOOC for South China Sea exploration	Feb.	15
Total Chine to produce from Weizhou structure	July	13
Total to produce in Beibu Gulf well soon	Aug.	15
Weizhou field produces first barrel	Dec.	11
CHINA OFFSHORE OIL DEVELOPMENTS & ENGINEERING		
Works with J P Kenny off South China coast	Nov.	80
CHROMALLOY AMERICAN CORP.		
Discontinues drilling fluids division	Sept.	57
CHUAN HUP MARINE		
Active in SE Asia offshore despite slump	Jan.	51
CLEAN GULF ASSOCIATES		
Adds new barge to fleet	Feb.	60
COASTAL COMMUNICATIONS		
Credit card telephones planned for platforms	Sept.	21
COASTAL CORP. Issue pg		
Offers limited partnership units in Drilling Program	Nov.	78
COCOON HOLLAND B.V.		
Electronics mothballing halts corrosion problem	Sept.	21
COGLA		
Interview with M. E. Taschereau	May	174
COMMUNICATIONS		
Cellular networks system readied for Gulf	Feb.	46
COMPANY NEWS		
Irregular feature		
Jan. p. 62; Feb. p. 66; May p. 180; Jun. p. 51; Aug. p. 102; Sep. p. 57; Nov. p. 78; Dec. p. 70		
COMPRESSION COAT INC.		
Awards concrete coating contract to Plexco	Nov.	80
Completes three concrete coating contracts	Dec.	64
COMPUTERS		
Braun composite terminals workstation alternative	Nov.	73
Computers aid seismic marine vibrators	July	32
New hardware, software products	Dec.	23
COMSAT		
Network for remote sites (Starcom)	Aug.	23
Testing 1.024-megabit service with Inmarsat	Feb.	25
CONFERENCES		
Offshore Decommissioning Conf. in London	Nov.	30
Offshore Northern Seas - list of exhibitors	Aug.	93
Offshore Safety meeting returns	Feb.	19
Offshore Southeast Asia - 260 exhibitors	Jan.	48
Offshore Technology Conference - over 1,000 expected	Apr.	159
PolarTech '86 links east-west technologies	Apr.	140
PolarTech '86 set for October	Aug.	109
PolarTech to feature ice, cold water technology	Sept.	56
CONOCO		
Foam fenders enable TLP mating	Aug.	84
Seeks lighter platform material	Jan.	23
Sees prices of $50/bbl	Nov.	6
To explore Gulf of Mexico with Nippon Mining	Nov.	13
V-Complex North sea, construction underway	Aug.	57
CONSAFE		
Capabilities split into Safe Offshore, Havila Offshore	Apr.	72
In licensing agreement with Tammco Unltd.	Jan.	62
CONSTRUCTION		
Robert E. Howson (McDermott Marine) on 1987 prospects	Dec.	33
CONTRACTS		
Irregular feature		
Feb. p. 62; May p. 181; Jul. p. 57; Aug. p. 105; Sep. p. 58; Nov. p. 80; Dec. p. 64		
COOPER ROLLS		
Gas turbine orders total $25 million	July	57
CORING		
Coring thru hull avoids punchthrough (Western Oceanic)	Aug.	42

Subjects	Issue	Page
CRT		
Too big and heavy but no substitutes available	Apr.	23
DANISH HYDRAULIC INSTITUTE		
Continues North Sea research	May	138
DAWSON OFFSHORE PTY.		
Has contracts for North Rankin A platform work	Aug.	105
DEEPWATER DRILLING		
UK and Norwegian North Sea probe deeper waters	Apr.	107
DEEPWATER WELLS		
Survey 1985start	Apr.	115
DELTA CONTROLS LTD.		
Amoco has oil discovery in North Sea	Oct.	11
BP orders control instruments for SE Forties field	Sept.	58
DENMARK		
Atlas water systems uses separator	May	138
Contractors push for offshore projects	May	134
Dan field old and least productive field	May	132
DENMARK (cont'd)		
Danes networking existing, new North Sea fields	May	131
Danish Hydraulics Inst. continues North Sea research	May	138
Directory of Danish services, contractors	May	140
Map - oil and gas transmission network	May	132
Planning under on 15 DUC discoveries	May	138
Risk assessment vital to new fields	May	138
Scale model set up for Dan field module by Odense Lindo	May	135
DIAB-BARRACUDE (Sweden)		
High tech foam resists crushing in deep water	Apr.	92
DIAMOND SHAMROCK CORP.		
Forming acquisition group	June	6
To sell coal subsidiary to Arch Mineral Co.	Sept.	57
DIESEL ENGINES		
Forney Eng'g new technology aids diesel monitoring	Jan.	58
DIETSMANN FRANCE S.A.		
Acquires Sud Marine Enterprises in France	Dec.	70
DIGISEIS SYSTEM		
Suited for 3-D swath coverage	July	45
DIGITRAN		
Directional drilling simulator introduced	Apr.	23
DILLINGHAM MARITIME		
Restructures division into new unit	Jan.	62
DISC NAVIGATION		
Laser disc sea charts	Apr.	5
DIVING		
Demand for divers may see dramatic increase	Nov.	6
Explosive tape for odd underwater shapes	Aug.	19
Huff (Oceaneering Int'l) comments on 1987 prospects	Dec.	35
Huff interview examines diving industry	Oct.	32
Investment costs take toll in Gulf, North Sea	Jan.	5
DOME PETROLEUM LTD.		
Reaches accord with creditors	July	6
DRILLING		
Analyst sees 10% cut in 1986 drilling	Jan.	6
Costs squeezed to maximum	Jan.	6
Cuts are more than envisioned	Aug.	6
Day rate contractors face challenge in weak market	June	15
Next two years to be worst ever	July	6
Troubled firms owe $5.1 billion	Oct.	30
Reed (Dyvi Offshore) comments on 1987 prospects	Dec.	32
Worldwide outlook heading down	May	7
1986 could be worst yet	Feb.	7
DRUG EDUCATION ASSOCIATES, INC.		
Says workers make their own drugs offshore	Jan.	32
DRUGS		
Drugs offshore reportstart	Jan.	31
Psychologist recommends diversion for offshore workers	Jan.	32
Tight control, communications needed	Jan.	33
DUC		
Danish company planning for 15 discoveries offshore	May	138
DUMPING		
Korea and Japan are guilty of dumping in U.S.	June	6
DUNLOP		
To choose site for new pipe facility in UK	June	6
DUPONT		
Launching slide plates have unusual quality	June	19
DYNO ENGINEERING A.S.		
Has Statoil contract for Sleipner A platform work	Dec.	64
DYNO INDUSTRIES A.S.		
To offer offshore services with Humphreys & Glasgow	Nov.	78
EASTMAN WHIPSTOCK		
Forms Eastman Christensen with Norton Christensen	Dec.	70
Proving up remote science of surveying	Mar.	23
EB ENGINEERING		
Has Agiba Petr. contract for Egypt transmission system	Aug.	105
Has Statoil contract for telecommunications systems	Sept.	58
EDITORIALS		
Protectionist laws work against nearly everyone	Jan.	29
Canada shows value of oil policy	Feb.	31
More incentives are needed to bring forth frontier oil	Mar.	27
Changes in leasing policy for U.S. offshore	Apr.	41
Finding a diamond in the rough	May	59
Low fuel prices creating demand	June	27
Good news has a tendency to spread	July	23
Talks stall on five-year leasing plan	Aug.	29
U.S. industry being handcuffed from within	Sept.	25
Support services have a separate economic reality	Oct.	25
Environmentally-minded Chevron trapped in Catch-22	Nov.	25
Good news, bad news scenario	Dec.	27
EGYPT		
Conoco producing from Geisum field	Jan.	12
First offshore ethylene unit	Mar.	19
Pushing for early production offshore	May	112
Texaco tests crude in Gulf of Suez	Sept.	13
Total group has discovery off Sinai	May	15
EKOFISK		
Reefs, nitrogen injection considered	May	145
Subsea completions	Dec.	47
EKONO CONSULTING ENGINEERS (Finland)		
Data overflow presents problems for production	Apr.	139
EL MARIN (AB) (Sweden)		
Wiring with complete diagrams	Apr.	80
ELECTRONIC RIG STATS		
Improves data distribution	May	19
EMH LTD.		
Boosting buoy swivel pressure loads	Aug.	19
Has Mobil SPM contract for Beryl field	May	181
Vega arctic tower installed off Italy	Nov.	52
EMH SYSTEMS INC.		
Tanker anchoring and production platform	Nov.	49
ENTERRA CORP.		
Moves headquarters to Houston	Nov.	78
ENVIRONMENTAL REASEARCH LABORATORIES		
Laser Doppler key to forecast reliability	Feb.	25
EPA		
Understanding new EPA mud rules for Gulf of Mexico	Sept.	45
ERC (UK)		
Has big international market for mngt professionals	May	164
ESCORT		
Artificial intelligence uses on platforms	Sept.	38
ESSO		
Signs with Norcem Comex Subsea for Odin inspection	May	181
ESSO AUSTRALIA LTD.		
Strike prompts contract termination	Apr.	6
EUROPE		
Dollar oil price and gas benefit Europe	Mar.	21
Gas supply review	Apr.	45
Leading offshore area now	Jan.	6
Offshore activity indices 1975-85	Mar.	21
Stockpiles winter heating oil	Dec.	5
EVODE		
Reel pipe coating developed in UK	June	19
EXPERT SYSTEMS		
Analysis proves diesel problems	Sept.	42
Computers with brains	Feb.	53
EXPLORATION		
Faster development of drillable prospects needed	Dec.	23
More cost cuts envisioned	May	7
Worldwide exploration & production figures start	May	118
EXXON		
Favors piled compliant tower	May	21
Lena guyed tower hints at future	Nov.	17
Rig inspection sparks feedback	Dec.	15
Ship collision tests compliant tower design	June	19
EXXON RESEARCH & ENGINEERING CO.		
3-year agreement with NBS for new instruments	May	180
FAR EAST		
Gas production comparison	Apr.	44
Gas situation in Thailand, Australia	Apr.	46
FELS		
Has Sudoimport contract for 4 oil spill recovery vessels	July	57
FERRANTI OFFSHORE SYSTEMS LTD.		
Completes Shell communications package in North Sea	Nov.	80
FERRANTI SUBSEA SYSTEMS LTD.		
Has Texaco contract for subsea control equipment	Sept.	58
FINLAND		
Expands into production, subsea, ice management systems	Apr.	123
Offshore prodcts, services	Apr.	155
FIREFIGHTING		
Wild well controlled in West Cameron block	Apr.	50
FLAKT (Sweden)		
Oseberg gets central vacuuming	Apr.	80
FLEXIBRAS		
Coflexip 2 Brazilian co's have pipe facility onstream	Sept.	57
FLEXURE		
Placid Shell developments continue midst uncertainty	Sept.	32
Status of deepwater projects	Sept.	32
FLOATING PRODUCTION SYSTEMS		
Maintenance costs five times higher	July	17
26 FPS now operating worldwide	Aug.	19
FLORIDA		
Significant potential in South Florida Basin	Dec.	11
FLUOR CORP.		
Forms joint venture with Dyvi in Norway	May	180
FMC CORP.		
Forms company with Sumitomo in Japan	Aug.	102
FMC FLUID CONTROL		
Relocates in Houston	May	180
FORAMER OE, INC.		
French contractor in deepwater rig market	Jan.	15
FORECASTS		
Rig use increase foreseen	Feb.	33
1987 outlook - dismal	Dec.	28

Subjects	Issue	Page
FORNEY ENGINEERING CO.		
New technology aids diesel monitoring	Jan.	58
FOSTER WHEELER PETROLEUM DEVELOPMENT (UK)		
Received 1985 Queens Award for Exports	May	166
Tension anchors used in arctic rig design	Feb.	19
FOXBORO CANADA INC.		
Vessel mngt services with Hoffman Maritime Consultants	Nov.	78
FRANCE		
Offshore industry pushes research	Aug.	21
Total concentrates on in-house research	Aug.	21
FRANKLIN SUPPLY CO.		
Files bankruptcy petition in Tulsa	Sept.	57
FREEPORT-MCMORAN INC.		
To buy Petro Lewis & American Royalty Trust	Sept.	57
FREIRE, WAGNER		
Braspetro president on 1987 production prospects	Dec.	30
FUEL CELLS		
Feasible but costly for offshore	Apr.	23
FUJAIRAH		
First well planned offshore	May	114
GAS		
Big gains in offshore production	Apr.	43
Brazil natural gas production 1975-86	Nov.	69
Controlling hydrates in deepwater	July	27
Far East gas production	Apr.	44
Growth in Brazil's gas reserves 1974-85	Nov.	69
High salt drilling fluid system	July	27
Major gas projects worldwide	Apr.	45
Middle East developments (Qatar)	Apr.	46
New offshore fields in Brazil boost gas reserves	Nov.	66
Norway broadening gas market search	May	145
Operational problems of shut-ins in Gulf of Mexico	Sept.	30
Scandinavian gas production plans (Norway, Denmark)	Apr.	45
Shut-in well completion problems 1985	Sept.	31
South American gas projects (Brazil)	Apr.	46
Stable prices may not spur gas market	May	68
Tool probes for gas origins	Jan.	23
U.S. consumption falling	Apr.	43
Worldwide offshore gas production	May	122
GASOLINE		
Demand up sharply in U.S.	July	5
GEC MECHANICAL HANDLING		
Has Hydraulik Bratvaag contract for evacuation system	Nov.	80
GECO		
Computers aid seismic marine vibrators	July	32
New plans with Texaco units	Aug.	102
GENERAL ELECTRIC		
Develops tomography scanning of oil cores	Dec.	23
GEO CACTUS WELLHEAD EQIPMENT CO.		
Forms company with Ingram Petroleum Services	Dec.	70
GEOLOGISTS		
Unemployment rivals1930s	Dec.	5
GEOTEAM UK LTD.		
Has two BP survey contracts	Sept.	58
GIPPSLAND BASIN		
Map of Australian region	Nov.	11
GLOBAL MARINE DRILLING CO.		
Average day rate received 1983-86	May	67
Average revenue per rig day 1983-86	May	67
GLOBAL MARINE INC.		
Files Chapter 11 after exhausting alternatives	Mar.	15
Interview with chairman of bankrupt firm	May	64
GLOBAL POSITIONING SYSTEM (GPS)		
Coverage array set back temporarily	July	45
GOTAVERKEN ARENDAL (Sweden)		
GVA pursuing market for production technology	Apr.	82
GRACE SYNTACTICS		
Has Placid contract for syntactic foam	Dec.	64
GUINEA-BISSAU		
African nation wants drillers	Jan.	6
GULF CANADA CORP.		
Discovery in Beaufort Sea on schedule	Apr.	167
GULF CELLULAR ASSOCIATES		
New communication system for Gulf of Mexico	Feb.	46
GULF ISLAND FABRICATION		
Has Union group contract for platform	July	57
Has Union Texas contract for two platforms	Aug.	105
GULF OF MEXICO		
Average well production low	Nov.	55
Block billing would reduce drilling	Jan.	5
Bullwinkle to be installed	Mar.	49
Cellular network system readied for Gulf	Feb.	46
Chevron leader in Gulf platform installations	May	82
Cognac, Bullwinkle: 10 years' difference	Feb.	38
Contractors take survival measures	Aug.	17
Costs of removing platforms	Nov.	30
Day rates Catch-22	Feb.	36
Deep water drilling may give new life to Gulf	May	78
Deep water projects	Feb.	45
Estimate of undiscovered reserves	May	82
Gas shut-in wells completions	Sept.	31
Higher developments costs outweighed by reserves	Oct.	17
Independents stir up activity	July	15
Jacket pile-cutting methods ffrom Mar-Con and Ocean Syst.	Dec.	19
Jackup rig demand falling	Mar.	65
Lease expirations 1985-89	Sept.	28
Low coast deepwater unit sought	Dec.	19
Map of lease sale 94	Feb.	13
Map - salt deposition	May	78
Most active seismic area 1985	May	81
Most active tracts	May	81
Number of wells by state	May	82
Operational problems of shut-in gas wells	Sept.	30
Operators locked in recessionary grip	May	78
Operators turning back good prospects?	Sept.	28
Placid/Shell developments continue amidst uncertainty	Sept.	32
Platforms listed by block, operator	May	84
Production profile of typical well	Sept.	28
Rates cause growing maintenance concerns	Apr.	15
Renewed activity expected in fall 1987	Sept.	27
Results of Gulf area-wide leasing	Feb.	45
Rig count should hit 100	Nov.	6
Rig count/spot price	Sept.	27
Rig fleet 1979-86	Oct.	29
Rig market hard hit by cutbacks	Apr.	178
Rig use increase foreseen	Feb.	33
Rig utilization rate 1980-85	Feb.	35
ROVs intervene in Gulf, Brazil	June	37
Shell top spender in sale 94, Amoco second	Feb.	14
SPECIAL REPORTstart	Feb.	38
Status of deepwater projects	Sept.	32
Subsea completions	Dec.	44
Top 10 tracts in sale 94	Feb.	13
Total bonus money 1985-89	Feb.	34
Understanding new EPA mud rules	Sept.	45
Washouts create footing problems in Mobile Bay	Mar.	19
Well to well contracts dominant	Feb.	37
Wild well controlled in West Cameron block	Apr.	50
129 million acres marked for next three sales	Dec.	6
1986 forecast: slowdown in Gulf drilling	Feb.	40
GULF OIL		
U.S. questions Angola stake	Mar.	54
GULLFAKS		
Schematic Phase I and II	Mar.	30
HAGGLUNDS & SONER (Sweden)		
Cooled disc brakes ideal for drawworks	Apr.	69
Sea Crab designed for heavy bottom work	Apr.	63
HALLIBURTON CO.		
Welex division introduces PLS logging service	Nov.	78
HAMANAKA CHAIN MFG. CO.		
New manufacturing plant ready soon in Japan	Feb.	66
HAN-PADRON ASSOCIATES		
Sliding ring protects arctic mobile unit	May	21
HARRINGTON & CO. INTERNATIONAL INC.		
New company for investment banking in oil and gas	Dec.	70
HAVILA OFFSHORE AB		
New company formed by Consafe managers	Feb.	66
HAVRON ENGINEERING CONSULTANTS		
Telemetry control of subsea wells	Dec.	23
HEDEMORA VERKSTALER (Sweden)		
Engine features welded block	Apr.	69
HEEREMA		
To contract for two launch barges	Jan.	17
HELICOPTERS		
Boeing 234s successful in Alaska's Navarin Basin	Mar.	61
Westland PLC crisis in UK	Mar.	36
HIBERNIA		
Mobil may let contracts soon to develop Canadian field	May	169
HITECH INTERACTION TRAINING INC.		
Delivers video training program to Conoco	Nov.	80
HOLLMING ENGINEERING WORKS (Finland)		
Thrusters expand Ulstein power, maneuverability	Apr.	125
HOLLMING LTD. (Finland)		
Building two geotech ships for USSR	Apr.	152
HOWARD DORIS		
Mid-East problems hurt UK production	Nov.	19
HOWSON, ROBERT E.		
McDermott Marine exec comments on 1987 prospects	Dec.	33
HUDSON ENGINEERING CORP.		
Platform study launched	Mar.	6
HUFF, JOHN R.		
Comments on 1987 diving prospects	Dec.	35
Oceaneering International exec interviewed	Oct.	32
HUGHES OFFSHORE		
Schematic of subsea tree used by Petrobras	Aug.	32
HUGHES TOOL CO.		
Plans to thwart acquisition	Mar.	6
Will merge with Baker International Corp.	Dec.	70
HUGHES-WKM		
Has Petrobras contract for subsea well trees	July	57
HUMPHREYS & GLASGOW LTD.		
Has Hydrocarbons Great Britain contract for Morecambe work	Aug.	105
HUNT FAMILY		
Says banks trying to thwart natural recovery	Sept.	33
HURRICANES		
No rash of hurricanes seen for 1986	Mar.	6
HUTHNANCE OFFSHORE		
Skid frame system for jackups	June	49

Subjects	Issue	Page
HYDRIL		
Riser diverter vents at seabed	Nov.	55
Threaded riser links cut time in makeup	Aug.	35
HYDROTECH SYSTEMS		
ANR uses repair connectors in High Island	Dec.	64
Delivers flanges to Vetco Gray	Aug.	102
Delivers Vetco-Gray flanges for subsea trees	June	57
ICE		
Polartech conference in Helsinki	Oct.	49
IFREMER		
Tetherless ROV near	Aug.	23
IMAC (Sweden)		
Paneling achieves sound reduction	Apr.	104
IMPALLOY (UK)		
Market leader in sacrificial anodes	May	160
IMPERIAL CORP.		
Moves offices to New Jersey	Nov.	78
INDIA		
Encouraged by third round responses	Nov.	11
Govt approves Schlumberger/Tatas venture	Feb.	8
Increasing platform security	Nov.	6
ONGC completes Kovilkalappal-3 well	June	13
ONGC gas find in Krishna Godavari Basin	Mar.	13
ONGC has discovery in Kaikular-3 well	Oct.	13
ONGC spuds Thavur-1 well in Cauvery Basin	June	13
Plans big domestic spending offshore	May	106
Reshapes tax policy to lure more exploration	July	19
Seeks foreign bids for 27 offshore blocks	Apr.	13
Seeks rigs to charter for offshore work	Nov.	15
Special cell formed to deal with offshore tracts	July	13
INDONESIA		
Diamond Shamrock signs with Pertamina	Mar.	12
Hudbay Oil discovers oil off Sumatra	Sept.	13
Hurt badly by oil price slump	Sept.	19
Recent offshore activity	Jan.	42
Suharto inaugurates Marathon's Kakap block KH	Aug.	15
Texas Eastern takes over Bawean block	Jan.	11
Unocal and Arco working offshore	Jan.	52
Who's doing what offshore	Jan.	46
INGEMANSSON AKUSTICK (Sweden)		
Machinery noise impacts workers	Apr.	98
Monitor reveals vibration	Apr.	69
INMARSAT		
Cost of ship-earth stations 1976-87	Jan.	38
Earth stations expand in face of difficulties	Jan.	38
Growth of Inmarsat users	Jan.	38
Releases Standard C technology	June	23
INSIGHTS & OPINIONS		
Regular feature each issue by Jim Redden		
Jan. p. 5; Feb. p. 7; Mar; p. 5; Apr. p. 5; May p. 7; Jun.-Dec. p. 5		
INSURANCE		
Increased premiums for offshore rigs	Dec.	15
Marine underwriters nervous	Nov.	6
INTERNATIONAL MARITIME ORGANIZATION (IMO)		
Plans lifeboat regulations	Nov.	5
Platform removal is staggering international issue	Nov.	27
INTERNATIONAL MARKETING CO.		
Formed to help companies market products overseas	Dec.	70
INTERNATIONAL OUTLOOK		
Regular feature each issue by Bart Milner		
Jan. p. 19; Feb. p. 23; Mar. p. 21; Apr. p. 21; May p. 23; Jun. p. 21; Jul. p. 21; Aug. p. 21; Sep. p.19; Oct. p.19; Nov. p. 19; Dec. p. 21		
INTERNATIONAL SUBMARINE ENGINEERING LTD.		
Researcher trials vessel jams fleet	Feb.	60
IRAN		
Nostrat field producing off Sirri Island	May	112
Retaliation for Iraqi attack envisioned	Oct.	5
IRELAND		
British Gas has good results in area off east coast	July	13
British Gas spuds well in Irish block	May	14
BP to postpone Irish drilling program	May	14
Marathon Petro. Ireland plugs and abandons Celtic 5 well	Aug.	14
Marathon to drill two Celtic Sea wells	May	14
May see record year of activity	Apr.	13
ISRAEL		
Egyptians advise Israel on offshore	June	11
ITALY		
Canada NW Energy abandons Venere No. 1 well	June	13
Vega arctic tower installed offshore	Nov.	52
J&W OFFSHORE (Sweden)		
Subsea foundation replaces anchors, templates	Apr.	58
J. LAURITZEN A/S		
To join Land & Marine Engineering in UK market	Nov.	78
JL OFFSHORE		
Selling 5 vessel rig fleet in Denmark	May	130
JACKET DESIGN		
Jacket piling configuration requires planning	June	56
Jacket re-use now possible	June	52
JACQUES ROTORK LTD.		
Has Oilfield Inspection Services cable system contract	Sept.	58
JAPAN		
Japan-Korean group drilling well on border	June	13

Subjects	Issue	Page
JARDINE, ALAN		
PA Computers exec comments on 1987 technology prospects	Dec.	38
JOHN BOOTH & SONS (UK)		
Has contract for stainless steel cladding system	Sept.	58
JOHN BROWN		
Completes engineering on Conoco's Logger platform	May	160
JOHN RALSTON & ASSOCIATES		
New company to survey commercial vessels	Sept.	57
JONES ACT		
Huff says awards getting out of hand in diving area	Oct.	32
JUMPPANEN, PAULI		
Wartsila exec comments on 1987 research prospects	Dec.	40
KAMEWA AB (Sweden)		
Deflection vanes improve thruster performance	Apr.	62
KANEB SERVICES INC.		
Diamond M signs contract for rig Diamond M Nugget	Nov.	80
KANTHAL AB		
Forms Chain Holding AB in Sweden	Dec.	70
KAWASAKI STEEL		
Building Bullwinkle elements	Apr.	19
KELLOGG-JGC-RAYMOND		
Has Woodside natural gas piping contract	Sept.	58
KJELLESVIC, SVEIN		
GECO president comments on 1987 seismic prospects	Dec.	34
KNOWLEDGE SYSTEMS INC.		
To apply artificial intelligence to oil & gas exploration	May	180
KONGSBERG VAPENFABRIKK		
Octopus system links Gullfaks platforms, base	Oct.	21
KVAERNER GROUP		
Floto design alternative to TLP	July	17
LABORATORY SPECIALISTS INC.		
Urinalysis test for drugs	Jan.	31
LANDMARK GRAPHICS		
Workstation key explortion decisions	Oct.	21
LARIKKA INNOVATION KY (Finland)		
Machine automatically cuts pipe from inside	Apr.	142
LASERS		
Disc Navigation laser disc sea charts	Apr.	55
Succeeds in spill detection, burn-off	Apr.	23
LAWRENCE INDUSTRIES		
To acquire Conductor Products Inc.	Dec.	70
LEASING		
Majority of sale 104 bids go to independents	June	5
Results of U.S. Gulf area-wide leasing	Feb.	45
Sale 104 Gulf of Mexico	June	15
U.S. action in California called a mockery	Apr.	6
U.S. lowers minimum per acre bid	Dec.	41
5-year lease plan is essential in U.S.	June	6
LEWIS OFFSHORE LTD.		
Has Nat'l Tank contract for glycol dehydration units	Sept.	58
LIBYA		
Agip developing huge Buri complex	May	117
LIEBHERR		
Supplies cranes to Reading & Bates	Feb.	63
To supply cranes to Atlantic Richfield in Indonesia	Aug.	105
LOUISIANA		
Conoco tests exploratory well in Green Canyon	July	12
Diamond Shamrock completes gas discovery Main Pass block	June	12
Diamond Shamrock completes state lease gas find	July	12
Diamond Shamrock producing from Mobil platform	May	14
Diamond Shamrock sales resume from West Cameron	July	12
Exxon USA has record production in South Timbalier	Jan.	12
Freeport-McMoRan discovers gas in Vermilion block	June	12
Freeport-McMoRan has gas discovery East Cameron area	Mar.	12
Halbouty Energy completed gas/condensate discovery	June	12
"Incentive" plan problems	Sept.	5
Lummus Crest has Conoco floater contract	June	12
Mobil has oil find in Garden Banks area	Nov.	12
Noble's Samedan has Vermilion gas find	Apr.	12
Samedan Oil has Vermilion gas discovery	May	14
Shell Offshore well sets depth record	Dec.	12
Tenneco producing gas and condensate Ship Shoal block	Jan.	13
Texaco has South Marsh Island gas discovery	Apr.	12
Texoil Co. discovers gas Main Plass block	June	12
Union Texas Petroleum confirms 1983 gas discovery	Apr.	12
LOUISIANA STATE UNIVERSITY		
Urges geochemical rock analysis	June	23
LTV ENERGY PRODUCTS		
Opens new store in Louisiana	Nov.	78
LUIGS, C. RUSSELL		
Interview with chairman of Global Marine	May	64
MACKENZIE DELTA		
Discussion of oil potential	Oct.	42
MAERSK ABERDEEN (UK)		
Recent export experience	May	164
MALAYSIA		
Esso, Sabah Sehll & Sarawak Shell seek more acreage	Oct.	13
Petronas president fears over-reaction	Sept.	5
Recent offshore activity	Jan.	42
Shell-Esso completes Trengganu complex	Jan.	52
Shell may spend $700 million there in 1986	May	110

Subjects	Issue	Page
MALONEY-CRAWFORD INC.		
Acquires 100% of stock of Williams Resources	Dec.	70
MAPPING		
NRD computer mapping	Apr.	68
MAPS		
Alaska - Endicott field	July	11
Australia	Sept.	11
Australia - Gippsland Basin	Nov.	11
Brazil - Campos Basin	Nov.	62
Brazil - Campos fields, production systems	May	94
California - active oil reservoirs offshore	Apr.	11
Denmark - oil and gas transmission network	May	132
Gulf of Mexico - lease sale 94	Feb.	13
Gulf of Mexico - salt deposition	May	78
Mediterranean - field development	May	117
North Korea	Aug.	13
North Sea - operating area for 10% wave height	Oct.	31
North Sea - Sleipner pipeline	July	48
West Australia	Jan.	51
West Australia discoveries	Jan.	52
Worldwide drilling theaters	May	76
MAR-CON INC.		
Removes platforms by pile cutting	Nov.	35
MARAD		
SEE ALSO U.S. MARITIME ADMINISTRATION		
Congress may restore foreclosure authority	Mar.	15
Policy hurts stronger boat companies	Mar.	36
Puts five rigs up for sale	Nov.	15
MARATHON LE TOURNEAU		
Has Helmerich & Payne contract for drilling rigs	July	57
To convert Penrod semi to production unit	Oct.	15
MARATHON OIL CO.		
To dissolve Libyan operations	June	5
MARINE CONSTRUCTION		
Regular feature each issue by Leonard A. LeBlanc		
Jan. p. 17; Feb. p. 21; Mar. p. 19; Apr. p. 19; May p. 21;		
Jun. p. 19; Jul. p. 19; Aug. p. 19; Sep. p. 17; Oct. p. 17;		
Nov. p. 17; Dec. p. 19		
MARINE CONSTRUCTION REPORT		
Special series of articlesstart	Nov.	36
Development linked with fixed mooring	Nov.	49
MARINE ELECTRONICS		
Data chart navigation starts up	Nov.	21
Four new systems for petroleum industry	Nov.	21
Microwave technology invades oil industry	Sept.	40
Need for expert system on large platforms	Sept.	38
MARINE NOTES		
Occasional feature - Feb. p. 60		
MARINE SAFETY SYSTEMS (Finland)		
Testing completed on hyperbaric lifeboat	Apr.	142
MARINE TRANSPORTATION		
SEE ALSO BOATS; VESSELS		
Annual boat surveystart	Mar.	40
Industry survival clouded	Nov.	13
Pact to scrap vessels fails in North Sea	Mar.	35
Plans for new boats revealed	Mar.	62
Top ten offshore vessel operators	Mar.	41
Zapata Gulf Marine acquires Seahorse Inc.	Mar.	34
MARINTEKNIK VERKSTADS AB (Sweden)		
Catamaran features replaceable hulls	Apr.	88
MARTEC CRANE SERVICES INC.		
To inspect Gulf of Mexico cranes	Feb.	66
MARTECH INTERNATIONAL INC.		
Manned submersible meets new demands	Nov.	74
MATHER & PLATT (UK)		
Has Statoil contract for Gullfaks downhole pumps	May	166
MATTHEW HALL ENGINEERING		
Orders riser system for BP SWOPS ship	Aug.	105
MC DERMOTT ENGINEERING		
Busy off Denmark with three platforms	May	160
MC DERMOTT INTERNATIONAL		
Automates design-to-fabrication (CADAD)	Jan.	23
Examining articulated launch units	Feb.	21
Has Conoco contract for Southern Basin gas facility	Dec.	64
Has Oseberg contract for pipeline	Aug.	105
Proposes conversion of DB100 to floating production system	Sept.	17
To build 3 new Chinese platforms	Mar.	19
Two jacket roll-ups set new records	June	19
MC TAGGART SCOTT		
Bow loader requires little conversion	Sept.	17
MEDITERRANEAN		
Lower area is serious offshore player	May	117
Map - field development	May	117
MERIDIAN OCEAN SYSTEMS		
Has McDermott contract for west coast survey	July	57
MESOTECH SERVICES LTD.		
Sonar developed to locate sunken logs	Aug.	40
MEXICO		
Ranks 5th in world oil reserves	May	102
MIDDLE EAST		
SEE ALSO SAUDI ARABIA		
Egypt is major rig employer	May	112
Gas development in Qatar	Apr.	46
MELLBANK ELECTRONICS		
Emergency computer guides reaction	Aug.	23

Subjects	Issue	Page
MINATONE CORP.		
To acquire exploration assets of Lear Petroleum Partners	Dec.	70
MIT		
Artificial intelligence sought for industry sectors	Sept.	21
Total ice vessel contacts results in overdesign	Feb.	21
MITSUI ENGINEERING & SHIPBUILDING		
Builds DB102 in Japan	Feb.	58
Establishes MITEC International Inc. in U.S.	Dec.	70
MOBIL OIL CORP.		
Contracts may be let soon to develop Hibernia field	May	169
Exec seeks universal cooperation	Nov.	5
Hibernian talks are on schedule in Canada	June	5
MOBILE RIG UPDATE		
Regular feature by Tim Cornitius		
Jan. p. 15; Feb. p. 19; Mar. p. 15; Apr. p. 15; May p. 19;		
Jun. p. 15; Jul. p. 15; Aug. p. 17; Sept-Dec. p. 15		
MONKRADLE ENGINEERING (UK)		
Has 2 contracts for North Sea maintenance gantries	Nov.	80
MONSANTO CO.		
Sells unit to BHP Petroleum Pty.	Feb.	66
MUD		
Analysts predict increase in mud business	Mar.	6
Costs vs. depth - graph	July	29
Understanding new EPA mud rules in Gulf of Mexico	Sept.	45
MWD		
Integration of MWD, well control technologies	Sept.	49
MWD tool taken to production phase	Sept.	52
NALCO CHEMICAL CO.		
Consolidates two divisions	Sept.	57
NATIONAL AIROIL BURNER CO.		
Radio control minicopter inspects flare stacks	July	21
NATIONAL DEFENCE RESEARCH INSTITUTE (Sweden)		
Lost bells survive with emergency heat	Apr.	88
NATIONAL ELECTRO		
To market safety system with Asea Per Kure	Nov.	78
NATIONAL ENGINEERING LABORATORY		
UK group completes work on seawater hydraulics	Sept.	17
NATIONAL SUPPLY CO.		
Closes plant in Los Angeles	Sept.	57
Has equipment order for Ivanhoe and Rob Roy fields	July	57
Moves offices in Houston	Feb.	66
NATIONAL TANK CO.		
Has Shell contract for Dutch desalting system	July	57
NATURAL GAS		
SEE GAS		
NAVAL CIVIL ENGINEERING LAB		
Footing works in various seafloor conditions	Jan.	17
NEI FAVCO		
Has North Sea orders for $4.5M in cranes	Dec.	64
NELES OYU (Finland)		
Develops deepwater diverless valve repair	Apr.	130
NEPTUN (Sweden)		
Neptun fleet mates Gullfaks	Apr.	78
NETHERLANDS		
Offshore production may be up 40% in 1986	Mar.	32
NEW PRODUCTS		
Regular feature each issue		
Jan. p. 67; Feb. p. 69; Mar. p. 66; Apr. p. 180; May p. 185;		
Jun. p. 61; Jul; p. 61; Aug. p. 110; Sep. p. 64; Oct. p. 62;		
Nov. p. 87; Dec. p. 72		
NEW PUBLICATIONS		
Regular feature each issue		
Jan. p. 71; Feb. p. 73; Mar. p. 69; Apr. p. 187; May p. 189;		
Jun. p. 65 Jul. p. 65; Aug. p. 113; Sep. p. 67; Oct. p. 65;		
Nov. p. 91; Dec. p. 75		
NEW ZEALAND		
May be 70% energy self-sufficient in 1986	May	110
NICOR MARINE INC.		
To work in Gulf with Sonat Subsea Services	Jan.	62
NIPPON KOKAN		
Launches Dyvi Offshore unit	Aug.	17
Marketing new OTEC plant	Sept.	57
NITROGEN		
Injection, LNG drive nitrogen research	May	25
NKK (Japan)		
Improved clad titanium claimed by rolling	Oct.	17
NL INDUSTRIES INC.		
Restructures petroleum service operations	Sept.	57
Sells Rucker Products to Amfac	Jan.	62
NOBLE, DENTON & ASSOCIATES		
Jackup fixity study	Feb.	60
Joint study with Int'l Process Services & Davies Offshore	Dec.	19
Study shows jackup stability better	Oct.	31
NOISE		
Average noise levels offshore	Apr.	98
Electronics cancel noise, vibration	Jan.	23
NOKIA TELECOMMUNICATIONS (Finland)		
Multiplex system joins data, voice channels	Apr.	149
NORCEM DRILLING AS		
To take delivery of first Aker H-4.2 semi	May	19
NORSK HYDRO		
Considers 4 platform designs for Troll field	Apr.	112
Disappointment of 3	Apr.	8

Subjects	Issue	Page
could mean end of giants	May	141
Most Oseberg contracts are let	Aug.	57
Production vessels contest marginal fields	May	146
Tests welding at 1200 ft.	Oct.	17
NORSK KABEL		
Has seismic cable order	Nov.	80
Orders seismic cables in Norway	Aug.	105
NORSKE SHELL		
Real-time bottom mapping with Bentech	Feb.	25
NORTH AMERICA		
Alaska, California, Canada, Mexico reportstart	May	99
NORTH KOREA		
Map	Aug.	13
May seek foreign aid east of Bohai	Aug.	13
NORTH SEA		
SEE ALSO NORWAY, UK		
Construction - much depends on govt support	Mar.	29
Demand forecast 1985-2000	Aug.	57
Danes networking existing, new fields	May	131
Discoveries in Netherlands, Denmark, Ireland	May	93
Discoveries north of 62nd	May	90
Divers working hits low in lst 6 mo. 1986	Dec.	6
Diving community is crowded	Jan.	5
Drillers weather price plunge	May	86
Foam fenders enable TLP mating on Conoco platform	Aug.	84
Low cost platforms invade area	Oct.	17
Map - Sleipner pipeline	July	48
Map - operating area for 10% wave height	Oct.	31
North of 62nd holds promise for Norway	Aug.	71
Norway may have vast reserves north of 62nd	Aug.	72
Occidental major subsea project starts at Scapa	Aug.	82
Pact to scrap vessels fails	Mar.	35
Phillips multi-platform lift set at Ekofisk	Aug.	64
Pipeline jolts industry awake	July	48
Predict 68-87 platform units thru 1990	Jan.	17
Review of possible field developments	Aug.	63
Seahorse platform for natural gas production	Mar.	52
Seismic now at 50% of 1981 level	Aug.	88
Subsea completions	Dec.	44
Sun Oil flexible risers used for Balmoral floater	Aug.	76
Technical optimizaton for new developments	May	23
Troll gas to Frigg, Norsk Hydro urged	Jan.	19
Two developments bid, two approved	Apr.	19
Water quality monitor for Phillips Maureen platform	June	46
NORWAY		
SEE ALSO NORTH SEA		
Adaptive controls used in crane compensation	May	158
Aker producer driller uses closed pontoons	May	146
Arctic concrete structures proposed	Oct.	46
BP says Gyda field is commercial	Dec.	12
Computer mapping to chart Norwegian hydrocarbons	Apr.	68
Conoco Norway completes delineation well Heidrun field	June	12
Contractors gear up for subsea work	May	155
Crude production still rising	Apr.	6
Determining rate of Ekofisk subsidence	Dec.	23
Disappointment of 3	Apr.	8
could see end of giants	May	141
Discoveries north of 62nd	May	90
Drillers seek tax relief	July	6
Ekofisk faces 50 cm/yr subsidence rate	July	17
Ekofisk reefs, nitrogen injection considered	May	145
Every citizen feels the oil pinch	Dec.	6
Expects to be dominant North Sea partner	June	21
Explorers see high profits	Jan.	6
Frontier areas surveyed by NRD	Apr.	68
Gas search broadening	May	145
Government 'should stress oil'	Feb.	8
Gullfaks A Condeep towed out	Aug.	58
Gullfaks C would be heaviest offshore structure	Feb.	21
Host of Norwegian fields set for subsea production	May	148
Karin platform installed by Saga	Apr.	110
Licensing shifts to north of 62nd	May	157
Listens to OPEC urging on lower output	July	19
Longer production lines create information needs	Oct.	21
Loses 4,000 oil jobs in current downturn	Oct.	6
New Norwegian fields in North Sea	May	90
New use for gas seen	Sept.	6
Norsk Hydro has highest gas flow	Feb.	15
North of 62nd holds promise	Aug	71
Phillips multi-platform lift set at Ekofisk	Aug.	64
Planning for future of offshore	Oct.	19
Production vessels can test marginal fields	May	146
Recent decision on offshore plans	Mar.	30
Saga may have problems developing Snorre	May	142
Saga's Snorre field to use floating production system	July	19
Several options weighed for Troll platforms	Jan.	19
Statoil completes test on Oseberg block	Sept.	12
Statoil tunnels may allow Troll field production	Apr.	110
Subsea and floating production techniques used	June	21
Subsea production units for export	Oct.	19
Tax relief does not go far enough	Oct.	6
Texas Eastern has 10% interest in 2 North Sea blocks	May	15
Total readying tests of polyphasic subsea system	May	158
Troll field to show new technology	Apr.	108
Vast reserves could open north of 62nd	Aug.	72
Ugland Eng'g's new oil loading system for Statfjord	Apr.	176
Ula field is BP's first Norwegian venture	Aug.	58
Will continue production cuts	Nov.	6
Yards are in trouble: FNEI says	Nov.	17
20 companies may test three Barents Sea areas	July	12
NORWEIGAN CONTRACTORS		
Develops concrete production floater	Nov.	17
NOVA SCOTIA		
Mobil Oil Canada completes testing West Olympia wildcat	Jan.	13
NOW WEATHER INC.		
TV signal carries weather graphics	May	25
NYNAS PETROLEUM AB (Sweden)		
Naphthenics reduce toxicity of fluids	Apr.	104
OCCIDENTAL		
Major subsea project starts at Scapa	Aug.	82
OCEAN RANGER		
New facts found in model study	July	15
OCEAN SYSTEMS ENGINEERING		
Completes subsea tools for BHP Petroleum Pty.	June	57
Has Texaco order for Harvest platform inspection	Nov.	80
Tool order delivered to BHP	Aug.	102
OCEANEERING INTERNATIONAL INC.		
Has Shell Offshore contract for drilling support	Sept.	58
Interview with John R. Huff	Oct.	32
Relocates headquarters from Houston to Aberdeen	Feb.	66
OCEANEERING NORWAY		
Has Inocean Construction contract for Gullfaks welding	July	57
OCEANO INSTRUMENT		
Sales rep for Hytec-Hydrotechnology products	Nov.	78
ODECO		
Buys Fluor Offshore drilling operation	Nov.	15
Kelly says downturn brings some opportunities	Oct.	5
President says price drop could be deadly	Feb.	8
Squabble over drilling record	Apr.	15
Uses ROV to recover BOP in Brazil	June	37
ODENSE LINDO		
Scale model set up for Dan field module	May	135
OFFICE OF TECHNOLOGY ASSESSMENT		
Ice research is critical need	Oct.	49
OFFSHORE DECOMMISSIONING CONFERENCE		
Meeting to be held in London	Nov.	30
OFFSHORE LOGISTICS INC.		
Returns 24 MARAD-backed vessels	Mar.	36
OFFSHORE NORTHERN SEAS		
List of exhibitors	Aug.	93
Norway's ONS bucks markets trend	Oct.	19
OFFSHORE PRODUCTION SYSTEMS		
Leased jackups offer low production outlay	Apr.	19
Worldwide surveystart ll/40		
OFFSHORE SAFETY		
Meeting to be held this year	Feb.	19
OFFSHORE SOUTHEAST ASIA		
260 exhibiting in show	Jan.	48
OFFSHORE TECHNOLOGY CONFERENCE		
Layout of exhibits in Astrodome	Apr.	164
List of exhibitors	Apr.	159
Over 1,000 exhibitors to attend	Apr.	159
Technical session timetable	Apr.	160
OIL INDUSTRY		
Analyst says downturn leaves permanent mark	Dec.	6
Balance in oil market seen	Oct.	6
Explorers should 'quit whining'	May	8
Free world oil supply/demand 1983-86	May	62
Hunt family blames banks for recovery problems	Sept.	33
Interview with chairman of Global Marine	May	64
Japan sees stabilization plan ahead	Apr.	6
Loss of expertise may take place	Aug.	5
Market beginning upturn?	Nov.	5
No end to slump seen	Apr.	6
'Oil Aid' fund raiser	May	8
Saudis target non-OPEC oil	May	61
Second half of 1987 could brighten	Aug.	5
Unsell of IPAA blasts economic 'vampirism'	Aug.	5
U.S. cutbacks to cripple future work	June	5
U.S. oil companies' earnings drop	Oct.	6
12 companies' earnings to drop $14 billion in 1986	July	6
OIL PRICES		
Analyst says rise to be maintained	Dec.	6
Collapse not fault of UK	Sept.	6
Fast down, fast up?	Apr.	5
High prices stimulate supply	Feb.	8
Increase seen by 1987	Oct.	6
Negativity on stocks said unjustified	Mar.	6
North Sea drillers weather price plunge	May	86
OPEC/non-OPEC	May	61
Pace says oil prices to edge up	Dec.	6
Price drop has winners, losers	May	8
Price hike seen in 4th quarter 1986	July	6
Price war envisioned by analyst	Mar.	5
Price war likely among producers	May	23
Rapid crude price hike seen	May	7
Salomon Bros. analyst sees price stabilization	Nov.	5
Schlumberger suggests minimum sales price	Dec.	5
Study shows low prices help economics	July	5
Surplus to pressure prices down	Feb.	8
Tight supply, high prices seen	June	6

Subjects	Issue	Page
UK and Norway face price war	Mar.	21
Warning of 'dead cat' theory	July	6
1986 to see $16-20 bbl.	May	63
OIL PRODUCTION		
Producing fields by country	May	125
Worldwide daily average production	May	120
OIL SERVICES		
Restructuring of sector near completion	Sept.	6
OIL STATES INDUSTRIES		
Develops PFC reusable jacket	June	52
Jacket flooding controls flexible, lightweight	Aug.	19
OILCONSULTANT		
Risk assessment vital to new fields (Denmark)	May	138
OPEC		
Output to hit record high?	Oct.	5
Production cuts have 50-50 chance in 1987	Dec.	5
1985 output was down	Aug.	6
ORCATION MANUFACTURING		
Diver communication transmitted acoustically	June	23
OREGON		
Luring oil explorers	June	5
ORGANISATION AND LEDNING AB (Sweden)		
Organized SAR transport services	Apr.	82
OSPREY ELECTRONICS		
Has Chinese contract for underwater cameras	Dec.	64
Has Reading & Bates contract for underwater TV systems	Sept.	58
PA OIL & GAS SERVICES		
Has Total contract for Alwyn training program	Sept.	58
PAN MARINE INTERNATIONAL INC.		
Charters SES vessel from Bell Halter	Feb.	63
PEMEX		
Awards contract to Celasa for Abkatun platform	July	57
PENNZOIL		
President says economics block offshore production	June	6
PENROD		
Wins safety award from MMS	Dec.	15
PEOPLE ON THE MOVE		
Irregular feature		
Feb. p. 59; May p. 178; Aug. p. 106; Sep. p. 60; Oct. p. 58; Nov. p. 82; Dec. p. 66		
PERRY OFFSHORE INC.		
Buys 4 SPRINT ROVs from SeaVision Enterprises	Dec.	70
Delivers Triton ROV to Woodside Offshore Petroleum	June	57
PERSONNEL		
Demand for senior managers at all-time low	June	6
Tech staff shrinkage not operator concern	Nov.	21
PETROBRAS		
SEE ALSO BRAZIL		
Aims at international status as oil producer	Nov.	71
Converts Aker semi for production	Sept.	15
Growth in gas reserves 1974-85	Nov.	69
Mulls choices for deepwater fields	Feb.	21
Natural gas production 1975-86	Nov.	69
New fields boost Brazilian gas reserves	Nov.	66
Subsea completion uses deepwater tree	Aug.	31
World's deepest production system	May	97
22 fields discovered	Nov.	57
PHILIPPINES		
Recent offshore activity	Jan.	48
PHILLIPS PETROLEUM CO.		
Doris back to work on Ekofisk	Nov.	19
Drilling budget slashed	May	7
Ekofisk has new platform for water injection	Aug.	58
Multi-platform lift set at Ekofisk	Aug.	64
Seeks okay to lift Ekofisk decks	June	19
Sells $2 billion worth of offshore properties	Oct.	5
Signs with Niject Service for plant building	Sept.	57
Water quality monitor for Maureen platform	June	46
3-D seismic on UK J-block	Dec.	21
PIONEER I		
Manned submersible of Martech International	Nov.	74
PIPELINE REPORTstart	July	48
PIPELINES		
Allseas Eng'g mechanical pipe trencher in North Sea	July	56
Brown & Root sets pipeline burial record in North Sea	Nov.	55
Thermal insulation for subsea pipelines	July	51
Troll and Sleipner to cost $7.7 billion	July	48
Two studies underway on deepwater systems	Mar.	19
PIPELINES INC.		
Contracts Chevron for West Cameron pipeline	Aug.	105
Has Tenneco contract for West Cameron pipe	Dec.	64
PLACID OIL		
On schedule with Green Canyon floater	Sept.	17
Proceeding with Gulf floating production system	Apr.	19
Production unit uses pre-set anchors	May	21
PLATFORMS		
Arctic concrete models under test	June	5
Arctic concrete structures proposed in Norway	Oct.	46
Blowouts greatest danger to fixed platforms	Nov.	75
Bullwinkle to be installed in Gulf of Mexico	Mar.	49
Costs of removing Gulf of Mexico platforms	Nov.	30
Damages to fixed platforms 1970-85	Nov.	75
Design cost now .5% of total installed cost	June	6
Design of Seahorse sparks interest	Mar.	52
Foam fenders enable TLP mating for Conoco	Aug.	84
Gulf of Mexico installed platforms	May	84
IFP, Vetco Gray study composite production riser	July	21
Need for expert computer systems on large platforms	Sept.	38
Norsk Hydro considers 4 platform design for Troll	Apr.	112
Platform removal staggering international issue	Nov.	27
Producers ask for protection from foreign yards	Jan.	5
Sea turtle bill halts use of explosives	Nov.	32
Skanska concrete design allows flexible deck layout	Apr.	63
Tecnomare working on Italian TLP	Apr.	170
Veritec study of blowouts on fixed platforms	Nov.	75
POLARTECH '86		
Conference set for October	Aug.	109
Helsinki site of meeting	Oct.	49
Links east-west technologies	Apr.	140
Meeting to feature ice, cold water technology	Sept.	56
POLLUTION CONTROL		
Utility ships adapt for spill cleanups	Feb.	48
PRIME COMPUTER		
Exploration seismic mapping system with ESI	Aug.	23
PROD		
Fishing pole concept seen as life saver	May	176
PRODUCTION		
Braspetro president comments on 1987 prospects	Dec.	30
PRODUCTION SYSTEM		
Vega arctic tower installed off Italy	Nov.	52
PUERTO RICO		
Offshore area being mapped	Jan.	6
PUMPS		
Weir Pumps develops subsea production pump	Dec.	41
QATAR		
North gas field underway	May	112
QUASCO		
Operators form group for quality appraisal	Feb.	23
QUBIT LTD.		
Tracking system can follow 3 targets	Oct.	21
R&D		
SEE ALSO RESEARCH		
BP extensive R&D in Norway	Dec.	21
Oil mergers hurt R&D in oil industry	Feb.	7
RACAL ACOUSTICS		
Helicopters being fitted with voice warning	June	23
RACAL SURVEY LTD.		
Positioning chain expanded	Feb.	60
RADAR		
Self-learning Susar system from Norway	Aug.	23
RAMCO TUBULAR SERVICES (UK)		
Doing well in Brunei market	May	164
RAUMA REPOLA (Finland)		
Diving equipment acquisition	Apr.	150
Expedition vessel completed for USSR	Apr.	146
Facility tests world's largest winches	Apr.	126
Has Aker contract for Gullfaks C steel	Aug.	105
Lokomec integrating hydraulics, electronics	Apr.	150
Planetary gears tested for elevating system	Apr.	139
Research developing better arctic tankers	Apr.	149
Steel arctic production unit has barge topsides	Apr.	125
Steel grades improved with vacuum technology	Apr.	140
Winged hydrographic vessel sweeps seabed	Apr.	46
READING & BATES		
Zane Barnes to work for Shell in Gulf of Mexico	Aug.	17
RED FOX INDUSTRIES		
Has barge repair contract for Temple Drilling	Feb.	63
REED, MANGE		
Dyvi Offshore exec comments on 1987 drilling prospects	Dec.	32
REG-TEK		
Adaptive controls used in crane compensation	May	158
REISS ENGINEERING		
Has Shell orders for Tern and Eider projects	Sept.	57
RELIANCE ELECTRIC CO.		
Centrifugal pump analysis	Jan.	62
RESCUE		
Fishing pole concept seen as life saver in Canada	May	176
RESEARCH		
SEE ALSO R&D		
Longer production lines create information needs	Oct.	21
Wartsila president comments on 1987 prospects	Dec.	40
RESMASTSERVICE (RMS) (Sweden)		
Hydraulic towers lift jacket	Apr.	82
RIG REPORT		
Regular feature each issue		
Jan. p. 64; Feb. p. 64; Mar. p. 65; Apr. p. 178; May p. 182; Jun. p.60; Jul. p. 58; Aug. p. 108; Sep. p. 62; Oct. p. 60; Nov. p. 84; Dec. p. 69		
RIGS		
SEE ALSO PLATFORMS		
Amer. Bur. Shipping issues guide for laying-up rigs	Dec.	59
Amethyst to be used as viewing stand for yacht race	July	5
Contractor mergers spur more rig retirement	Dec.	15
Contractors seek stability in 1987	May	182
Corrosion not problem in 10-year old rig	Oct.	15
Day rates Catch-22 in Gulf of Mexico	Feb.	36
Economics return rig use to 1970s era	Oct.	27
European rig construction to be minimal	Mar.	32
Noble, Denton study shows jackup stability better	Oct.	31
Rig use increase foreseen	Feb.	33
"Rigs-to-reef" movement in Congress	Mar.	5

Subjects	Issue	Page
SOUTH KOREA		
Joint work offshore with U.S.	May	15
SOUTHEAST ASIA		
SEE ALSO ASIA		
BP finds opportunities offshore	Jan.	54
How reserves compare	Jan.	54
Offshore SE Asia in January	Jan.	48
ROV intervention designed for Jabiru	Aug.	100
SOVEREIGN OIL & GAS CO.		
Leader in deepwater drilling North Sea	Apr.	107
SPAIN		
Oxy abandons activity	Aug.	15
Reduced offshore exploration	May	117
SPEAKING OUT		
Regular feature by Robert G. Burke		
See Authors (Burke, Robert G.) for list of titles		
SPUNALLOYS LTD.		
To market special castings in West Germany	Sept.	58
SSPA MARITIME CONSULTING (Sweden)		
Program minimizes power in positioning system	Apr.	78
Testing completed on GVA 5000 semi unit	May	129
STATE BOAT UNITED INC.		
Offers 'free' boat rental plan	Apr.	6
STATOIL		
Awards contract to Standard Telfon for Gullfaks cable	July	57
Awards two module contracts to Dragados yard in Spain	Nov.	80
Focusing on fewer, smaller platforms	Sept.	17
Gears for tight 1986	May	8
May install new Norwegian line	Feb.	21
Tommeliten to see diverless installation, production	Aug.	57
Tunnels may allow Troll field production	Apr.	110
STENA AB (Sweden)		
Adds test facilities to well servicing vessel	Apr.	64
STRAINSTALL (UK)		
Sells strain guage instruments for Gulf arctic use	May	162
SUB POWER (Sweden)		
Stirling engine readied for submarine support	Apr.	70
SUBSEA ENTERPRISES A/S		
Acquires 66% of Koomey Inc.	Jan.	62
SUBSEA EQUIPMENT		
ROV marriage near	June	32
Subsea completion in Brazil uses deepwater tree	Aug.	31
Subsea foundation replaces anchors, templates	Apr.	58
SUBSEA INTERNATIONAL INC.		
Has McDermott Marine contract for diving services	Sept.	58
Record BOP recovery in Gulf of Mexico	June	38
SUBSEA OFFSHORE		
ROV vessel ready for action	Mar.	62
Subsea welding methods with North Sea Hyperbarics	Apr.	19
SUBSEA PRODUCTION		
Completions by water depth and status	Dec.	44
Completions by year and method 1961-85	Dec.	48
Gullfaks A state-of-the-art in subsea development	June	29
Host of Norwegian fields set for subsea production	May	148
Increased emphasis to impact rig utilization	June	29
Latest development in tanker loading for subsea	Dec.	56
Tommeliten subsea project	June	31
Worldwide review since 1960start	Dec.	51
PRODUCTION HANDBOOK		
Special reportstart	Dec.	43
SUN EXPLORATION & PRODUCTION CO.		
New center to be completed in summer	Feb.	66
Wild well controlled in West Cameron block	Apr.	50
SUN OIL		
Flexible risers used for Balmoral floater	Aug.	76
Orders Terranti support package for Balmoral	Dec.	70
SUPPLY BASES		
Notes on 3 new facilities planned	Jan.	17
SUPPORT VESSELS		
Names of support vessels under construction	Mar.	40
SVENSKA SKUMSLACKNINGS AB (Sweden)		
Compact fire monitors located on mast	Apr.	105
SWACS		
Acoustic controls prototype system tested	Mar.	23
SWEDEN		
April issue to feature Swedish technology	Mar.	57
Special series of articlesstart	Apr.	53
Technological advances solve offshore problems	Apr.	53
SWEDISH NATIONAL DEFENCE INSTITUTE		
Pulse-Doppler system spots Arctic bergs	Apr.	94
TAIWAN		
CBK structure to produce in August	May	110
Recent offshore activity	Jan.	48
TANKER LOADING		
Latest developments in tanker loading for subsea	Dec.	56
TAXES		
Tax reform to prompt more mergers?	Dec.	5
TAYLOR DIVING		
Awards contracts to Shell and Mobil	Feb.	57
Completes Exxon order for West Delta sandbags	Dec.	70
Improved design, electrodes needs for wet welding	Nov.	76
TAZERKA		
Bearings vital to pivotal mooring in Tunisia	Apr.	97
TECHNICAL RESEARCH CENTER (Finland)		
Growth of tube joint fatigue cracks charted	Apr.	154
TECHNIP GEOPRODUCTION (France)		
Signs with EIL in India	Nov.	80
TECHNOLOGY		
Downturn is helping advance technology	Aug.	5
1987 prospects reviewed by PA Computers president	Dec.	38
TECHNOMARE SPE		
Forms company in Norway with Norske Veritas	Nov.	78
Working on Italian TLP	Apr.	170
TELE-DRILL INC.		
MWD tool taken to production phase	Sept.	52
TEXACO		
Gulf drilling could rebound	Jan.	6
Plans for Petronella field in North Sea	Aug.	57
TEXAS		
Amoco Production has gas discovery in Gulf of Mexico	Sept.	13
Offshore output up slightly	Nov.	6
Oil industry may face long depression	Sept.	5
Seagull Energy delivering gas from Matagorda Island	Sept.	13
TXP drills gas well North Padre Island	Mar.	13
Union Exploration has gas find Mustang Island	Dec.	11
Union Exploration producing from Gulf of Mexico platform	Oct.	11
TEXAS EASTERN		
Combines drilling operations with W. R. Grace	Sept.	57
TEXAS GAS EXPLORATION GROUP (UK)		
Has acceptances for 90% of ISE shares	Nov.	78
TEXAS IRON WORKS INC.		
Establishes new company in West Germany	May	180
THAILAND		
Gas is major blessing; no oil offshore	May	110
Recent offshore activity	Jan.	42
THORN EMI		
Software integrates development projects	Sept.	21
THREE QUAYS (UK)		
Small company has contracts in Vega, Espoir fields	May	164
THRUSTERS		
Anchor assist now automatically controlled	Apr.	78
TIDEWATER INC.		
President comments on marine transportation	Nov.	73
Sells Hilliard Oil & Gas to Graham Resources	Feb.	66
TIDEWATER MARINE SERVICE INC.		
Buys 4 supply vessels for $2 million	May	8
TOTAL		
Readying tests of polyphasic subsea system in Norway	May	158
TRACKTECH (Sweden)		
Electronic ranger tracks vessels	Apr.	69
TRAFALGAR HOUSE OFFSHORE		
Bids on Indian gas development project	May	160
TRANSPORTATION		
SEE ALSO MARINE TRANSPORTATION		
Kenneth W. Waldorf comments on 1987 prospects	Dec.	39
TRANSTEMA KOCKUMATION (Sweden)		
Computer manages vessel, cargo, communications	Apr.	94
TRANSWORLD DRILLING		
Launches Mr. Mac jackup; has no contract	Sept.	15
TRAVOCEAN		
Unit recycles helium for diving	Dec.	21
TRINIDAD		
Turns to offshore gas during oil slump	Sept.	19
TRITON ENERGY CORP.		
Merges with Worldwide Energy	Nov.	78
TRIUMPH DRILLING TOLLS INC.		
Merger with LOR, Inc. complete	Feb.	66
TUNISIA		
Area off Sicily has significant discoveries	May	117
Bearings vital to pivotal mooring	Apr.	97
UDDCOMB SWEDEN AB		
Machining Gullfaks buoy articulations	Apr.	100
UGLAND ENGINEERNG AS		
New oil loading system for Statfjord	Apr.	176
UIE CLYDEBANK (UK)		
Gorilla class jackup on export list	May	162
UNDERWATER SYSTEM		
ACB Offshore dept. lets contract to Smit Tak	Nov.	80
UNION CARBIDE CORP.		
Opens customer support center in Houston	Feb.	66
UNION OIL		
To drill in Santa Maria Basin off California	May	101
UNITED KINGDOM		
British services/equipment directory	May	168
Britoil may develop North Sea gas	Mar.	32
Britoil releases test results in Brae/Miller well	June	11
Britoil/Texaco find east of Shetlands	May	13
Clyde, Brae and other fields	Aug.	60
Chevron tests well that may link to Premier find	Dec.	12
Conoco tests gas appraisal well	Apr.	12
Conoco has successful test east of Shetlands	Aug.	13
Consultant optimistic on North Sea medium to long term	Apr.	6
Discovery rate still high	May	86
Drillers seek tax repayment	Aug.	6
Drilling up in early 1986	May	8
Etterick may be developed in 1987	Mar.	31
Exports blooming; smaller companies sell abroad	May	159
Hamilton Oil completes exploration well drilling	Mar.	11
Hamilton Oil completes Innes field development well	Jan.	12
Hamilton Oil has encouraging wildcat	May	14
Hamilton Oil releases North Sea test results	June	11

Subjects	Issue	Page
List of successful wells	May	89
Marathon Oil completes testing Central Brae well	Jan.	12
Marathon Oil drills 4-mile deep well in South Brae	June	11
Mobil has discovery in Southern gas basin	Sept.	13
Mobil wildcat to be part of Beryl field	Aug.	13
New gas developments seen in 5-10 years	June	21
North Sea cash flow could slide $1 billion	Sept.	5
Occidental has oil and gas discovery NE of Aberdeen	Jan.	12
Occidental tests appraisal well	May	13
Offshore activity indices 1968-85	Mar.	21
Phillips Petroleum completes appraisal well	May	14
Promising projects in North Sea	Mar.	31
R&D investment is $189 million	Jan.	11
Ranger Oil successfully tests Frigg gas well	July	12
Rig requirements down 14%	May	86
Rig use increase foreseen	Feb.	33
Several significant discoveries announced	May	13
Shell has two gas fields ready for production	Dec.	12
Sovereign Oil & Gas has successful Forties well	Apr.	12
Still is most active oil province	July	6
Ten oil and gas developments approved for North Sea	Oct.	12
Tern and Eider field activity	Aug.	58
Texaco developing $60M Petronella satellite	June	21
Texaco has second discovery on North Sea block	Mar.	11
Texaco North Sea UK has two oil and gas finds	Jan.	11
To spend $30 billion in North Sea in next decade	July	5
UNITED STATES		
"Buy American" campaign in Congress	Feb.	7
Domestic rotary rigs 1981-86	May	63
Frontier drilling aid needed	Aug.	6
Gross drilling expenditures 1975-83	May	63
IPAA sees oil activity at all-time low	Sept.	6
Legislation looks favorable for offshore drillers	Oct.	15
Lowers minimum per acre lease bid	Dec.	41
Reagan shows political 'savvy'	Sept.	5
Rig use increases foreseen	Feb.	33
Shut-in completions rise	Aug.	6
West Coast down to two working rigs	Feb.	64
U.S. COAST GUARD		
Seeks comments on vital system automation	Feb.	60
U.S. MARITIME ADMINISTRATON		
SEE ALSO MARAD		
Contracts in force	Oct.	28
Worldwide fleet 1979-86	Oct.	28
U.S. NAVY		
Installs floater in deepwater off California	Aug.	99
UNIVERSITY OF ABERDEEN		
Underwater holography improves 3-D imaging	June	23
UNOCAL		
New way to analyze carbonate formations	June	2
USS OILWELL SUPPLY CO.		
Has Ecopetrol contract for 114 pumping units	Aug.	105
USSR		
Barents Sea far short of 1981-85 goal	Sept.	12
Caspian Sea to have 5-10% increase in 1986	May	110
Difficult decisons to be made on polar exploration	Oct.	41
First wildcat drilled in Caspian Sea	Mar.	11
Petroleum sector surpassing U.S.?	Nov.	6
Significant growth possible in oil market	Sept.	19
Soviets deploy semi for Caspian Sea duty	Feb.	19
14 more wells slated for 28th of April field	Mar.	12
VALMET (Finland)		
Building Soviet dive vessel for Caspian Sea	Apr.	130
Forms new company with Wartsila	Aug.	102
Has USSR order for diving support vessel	Sept.	58
Studies Chukchi with Intec	Apr.	142
VALMET OFFSHORE		
Reconditioning accomodation modules	May	130
VALVES		
Veritas claims diverters fail in 50% of blowouts	Nov.	54
VBB (Sweden)		
Program analyzes flexible risers	Apr.	90
VENEZUELA		
Lake Maracaibo expanded in 1985	May	97
VENTROL (UK)		
Sells packaged process plants in Norway, Mideast	May	162
VERITAS RESEARCH		
Claims diverters fail in 50% of blowouts	Nov	54
VERITEC		
Says welding leading cause of platform fires	July	17
Study shows danger of blowouts to platforms	Nov.	75
VERSATILE PACIFIC SHIPYARDS		
Hopes to build arctic structure	Aug.	109
VESSELS		
SEE ALSO BOATS; MARINE TRANSPORTATION		
Expert system analysis probes diesel problems	Sept.	42
Ice forms faster than thought	July	6
Stena AB adds test facilities to well servicing vessel	Apr.	64
VETCO OFFSHORE NORGE		
Has contract for Elf's East Frigg project	Nov.	78
VIETNAM		
Joint Soviet venture has oil find south of Vung Tu	June	13
Production to begin from White Tiger field	Mar.	13
Recent offshore activity	Jan.	48
Seeks outside help for oil development	July	19
To begin production on White Tiger field soon	May	110
VULTURE FUNDS		
Capitalizing on bargain basement deals	May	7
WARTSILA (Finland)		
Arctic Research Center studies ice forces	Apr.	128
Expert systems analyzes diesel problems	Sept.	42
Largest heavy lift transport in fabrication	Apr.	130
Pusher barge system operates in thick ice	Apr.	124
WARTSILA ENVIROVAC SYSTEMS		
Dual waste handling installed on Goodrich	Apr.	150
WATER QUALITY MONITOR		
Phillips technology for Maureen platform	June	46
WATERCRAFT LTD.		
Fishing pole concept seen as lifesaver	May	176
WEATHER OUTLOOK		
Regular feature each issue		
Bay of Campeche	Sept.	11
Central Gulf of Mexico	June	11
Grand Banks	Feb.	13
North Sea	Jan.	11
Northwest Australia	Dec.	11
Sicily, Adriatic Sea	Nov.	11
South China Sea	Apr.	11
Southern Brazil	Oct.	11
Southern Peru	July	11
Strait of Magellan	Mar.	11
West coast Africa	May	13
Western India	Aug.	13
WEEDO BATAR AB (Sweden)		
Man overboard boat uses water jet, diesel	Apr.	104
WEIDLER, JAY B.		
Interview with Brown & Root exec on marine construction	Nov.	36
WEIR DRILLING		
To market turbo drills in UK	Jan.	15
WEIR PUMPS		
Develops hydraulic pump with Britoil	May	166
Has contract for Shell Tern pump sets	Sept.	58
Scottish firm develops subsea production pump	Dec.	41
WELDING		
Improved design needed for wet welding	Nov.	76
WELL CONTROL		
Integraton of MWD, well control technology	Sept.	49
WELLDRILL LTD.		
Has Century Power & Light contract for North Sea study	July	57
WELLS		
International offshore well count by country	May	118
WEST AUSTRALIA		
SEE ALSO AUSTRALIA		
Map	Jan.	51
Map	Jan.	52
WESTERN GEAR (UK) LTD.		
Sells riser tensioners to Offshore Europe	Aug.	102
WESTERN GEOPHYSICAL		
3-D swath coverage	July	45
WESTERN OCEANIC		
Coring thru hull avoids punchthrough	Aug.	42
WIJSMULLER SALVAGE B.V.		
New company formed with Offshore Tugs	Aug.	102
WILHELMSEN MARINE SERVICES		
New underwater service company formed	Aug.	102
WILLIAMS BROTHERS ENGINEERING		
Has Botos contract for services in Turkey	Nov.	80
WIMPEY LABS		
ROV grant system cuts out pipework, diver	Aug.	40
WIWA SVENSKA AB (Sweden)		
Develops new air dehumidifier	Apr.	76
WOODSIDE OFFSHORE PETROLEUM PTY. LTD.		
Awards $40M in contracts for equipment protection	May	181
Buys Triton ROV from Perry Offshore	Aug.	102
Subcontracts let for NW Shelf cabling	Nov.	80
WORLD ENERGY OUTLOOK		
Chevron publication sees lower demand	Sept.	6
WORLD OFFSHORE		
Regular feature by Jim Redden		
Jan. p. 11; Feb. p. 13; Mar. p. 11; May p. 11; Jun. p. 11; Jul. p. 11; Aug. p. 13; Sep.- Dec. p. 11		
ZAPATA CORP.		
Gets financial relief from banks	Oct.	15
Lassiter says lowballing hurts market	May	74
Performance-based Shell contract	Jan.	15
Records loss of $51 million	Oct.	6
ZAPATA GULF MARINE CORP.		
Gulf Service tug/supply boat	Feb.	60
ZAPATA OFF-SHORE		
Jackup Miss Kitty accident-free for 4 years	Nov.	15

Subjects	Issue	Page
Supply overshadows demand	Oct.	27
U.S. Maritime Adm. contracts in force	Oct.	28
What major drilling companies owe on rigs	Oct.	30
Worldwide fleet 1979-86	Oct.	28
Worldwide use hits 50% level	July	6
RIGS TO REEF CO.		
Proposes artifical reefs be made from old rigs	Nov.	28
RISERS		
Flexible risers used for Balmoral floater by Sun Oil	Aug.	76
RIVER DON CASTINGS (UK)		
Among world leaders in cast nodes	May	166
ROCIS		
Asea crack inspection device operates remotely	Apr.	58
ROLLS ROYCE (UK)		
Sells turbines to Norway, France	May	162
ROSS DRILLING		
New mobile rigs going to Stavinger	Sept.	15
Takes over semi Ross Rig	Aug.	17
ROV		
Design changes key to ROV-assist	June	32
Ifremer tetherless ROV near	Aug.	23
Increased capabilities important	June	34
List of ROV contractors	June	39
List of ROV manufacturers	June	41
ROV intervention designed for Jabiru	Aug.	100
ROVs intervene in Gulf, Brazil	June	37
Sonat Subsea Services unit proves worth	June	39
Subsea Offshore ROV vessel ready for action	Mar.	62
Unmanned pipe trencher augmenting capabilities	Aug.	23
Wimpey Labs grout system cuts out pipework, diver	Aug.	40
ROYALTY TRUSTS		
Oilfield royalty trusts at all-time low	Oct.	6
SAB NIFE (Sweden)		
Photovoltaic capability designed	Apr.	76
SAFETY		
Arabian Gulf war zone transit hazard to vessels	Aug.	38
Rig inspection sparks feedback	Dec.	15
SAGA		
May have problems developing Snorre field	May	142
Says Snorre to stay on schedule	Apr.	21
SAIPEM		
Italian driller sees upturn in rig demand	Feb.	19
SALTECH CONSULTANTS AB		
Delivers computer control system to Dutch company	May	19
SALVESEN DRILLING SERVICES		
Opens new headquarters in Aberdeen	May	180
SANVIK STEEL (Sweden)		
Stainless steel use downhole increasing	Apr.	85
SATELLITES		
GPS coverage array set back temporarily	July	45
Inmarsat earth stations expand in face of difficulties	Jan.	38
Starfix navigation and positioning system	July	41
SAUDI ARABIA		
Analyst says Saudis 'sold out OPEC'	Apr.	5
Details sparse but production increases	May	114
Imports to U.S. tripled in early 1986	Dec.	6
May hit ceiling on crude production	Apr.	21
Offshore production - OPEC non-OPEC 1979-84	May	61
Saudis target non-OPEC oil	May	61
SAVAL-KRONENBURG		
Moves to new premises in Holland	Dec.	70
SCANDINAVIA		
Plans for gas production in Norway, Denmark	Apr.	45
SCANDIANVIAN CHAIN REPAIR (Sweden)		
Chain testing, repair facility	Apr.	76
SCANDING OFFSHORE AB (Sweden)		
Engineer recommends bolted jacket K-joints	Apr.	60
SCAPA FIELD		
Schematic of Oxy development	Mar.	30
SCHEEPSWERF DE HOOF		
Orders control system for Saltech Consultants	Aug.	102
Orders parts control system	June	57
SCHLUMBERGER		
Compensation eliminates wireline heave	Aug.	35
Readying efficiency tool (MEL)	Jan.	23
SCM CORP.		
Sets up Glidden hotline	Feb.	66
SCOMAGG HYDRAULICS LTD.		
Has contract for Waverider winch system	Sept.	58
SCOTLAND		
Hopes for Moray Firth brighten	Sept.	56
SCOTTISH DEVELOPMENTAGENCY		
Is low cost technology exporter	June	6
SEA-CON SERVICES		
Has Shell PipeLine contract for welded hot tap	Sept.	58
SEA CRAB		
Designed in Sweden for heavy bottom work	Apr.	63
SEA TURTLE		
Use of explosives endangers sea turtle	Nov.	32
SEABOARD WELLHEAD INC.		
Joint venture with F. H. Lloyd Holdings for valves	June	57
Venture with F. H. Lloyd Holdings described		
SEAGULL ENERGY CORP.		
Pipeline expansion system for PLT Engineering	Feb.	63
SEAHORSE		
Platform design sparks interest	Mar.	52
SEALUBE INC.		
New company to seal pipe joints	June	57
SEAMETRIX LTD.		
Becomes independent of Resources Technology plc.	May	180
Sells ROV to Offshore Diving & Salvaging	Dec.	64
SEAPLACE INTERNATIONAL		
Heavy lift, shallow draft sought for North Sea	Feb.	21
SEAVISION ENTERPRISES INC.		
To build small robot with Bentex Inc.	Sept.	57
SECURITY CONCEPTS INTERNATIONAL INC.		
Drug detection program	Jan.	31
SEISMIC		
Computers aid seismic marine vibrators	July	32
Current seismic at 50% of 1981 level	Aug.	88
Explorers cut new trails	July	30
High resolution seismic possible	July	35
Strategies improve seismic efficency	July	42
Technical changes are underway	July	30
3-D accounts for half of U.S. marine seismic	July	31
3-D surveys unique	July	35
1987 prospects reviewed by GECO president	Dec.	34
SEMBAWANG SALVAGE CO.		
Buys Pan Asia yard in Jurong	Nov.	78
SFD (Sweden)		
Oil retrieval vessel uses rotary collector	Apr.	102
SHARJAH		
Producing from Saaga field	May	114
SHAW AND HATTON (UK)		
Strong North Sea base for surveys	May	162
SHEFFIELD FORGEMASTERS (UK)		
Exports products to U.S., Norway, Far East	May	164
SHELL CANADA PRODUCTS		
Orders Delaval compressor	Dec.	64
SHELL ESSO		
Current North Sea work	Mar.	31
SHELL OFFSHORE		
Orders geophysical survey system from Magnavox	Dec.	64
Power, data cables link Elly, Eureka platform	Aug.	99
SHELL OIL		
First unmanned platform slated for UK field	Aug.	19
New techniques employed for giant Bullwinkle structure	Mar.	49
Placid/Shell developments in Gulf of Mexico	Sept.	32
Study shows offshore oil/gas best buy	Apr.	5
SHELL PETROLEUM DEVELOPMENT		
Extends Oceaneering International contract in Nigeria	May	181
SHELL UK EXPLORATION & PRODUCTION		
Awards Bardex contract for Tern platform skids	May	181
Awards Tern and Eider contracts to Inspectorate EAE	Aug.	105
Impalloy supplies pump fouling solution	Feb.	63
SHIPS		
SEE ALSO BOATS; VESSELS		
Utility ships adapt for spill cleanups	Feb.	48
SIMRAD SUBSEA		
Has Kongsberg Albatross contract for navigation system	Aug.	105
Marketing plan with Kongsberg Albatross	Jan.	62
SINGAPORE		
Recent offshore activity	Jan.	42
SINGLE BUOY MOORINGS INC.		
Has Shell Sarawak order for anchor leg mooring terminals	May	181
SKANSKA AB (Sweden)		
Concrete design allows flexible deck layout	Apr.	63
SKARPENORD & CONTROL SYSTEMS		
Establishes two new companies in Norway	Dec.	70
SKF ENGINEERED PRODUCTS (Sweden)		
Roller screws link TLP tensioning members	Apr.	72
SKF STEEL AB (Sweden)		
Cold-rocked steel resistant to H2S	Apr.	102
SKIDOFF RIGS		
Huthnance skid frame system for jackups	June	49
SMIT INTERNATIONAL		
Has orders for many new boats	Mar.	62
Working on foam concentrate with National Foam Systems	Jan.	62
SMIT TAK		
Orders anti-fouling system in Holland	Dec.	64
SNORRE		
Saga/Esso project development	Apr.	108
SOHIO ALASKA PETROLEUM CO.		
Endicott field on schedule as first producer	May	99
SONAR		
Mesotech Services sonar to locate sunken logs	Aug.	40
SONAT INC.		
Completes purchase of half of Enron Corp.	Sept.	57
Henry Goodrich begins first hole for Elf	Apr.	15
SONAT SUBSEA SERVICES INC.		
Forms company with Wilhelmsen Marine Services	June	57
ROV proves worth in cleaning, inspection work	June	39
Sells Gulf of Mexico division to American Oilfield Divers	Dec.	70
SOTHERD & PITTS (UK)		
Sells 40 cranes in North Sea	May	160
SOUTH AFRICA		
Mossel Bay gas field to have long life	Oct.	6
SOUTH AMERICA		
Gas projects in Brazil	Apr.	46
Giant Campos finds boost reserves	May	94